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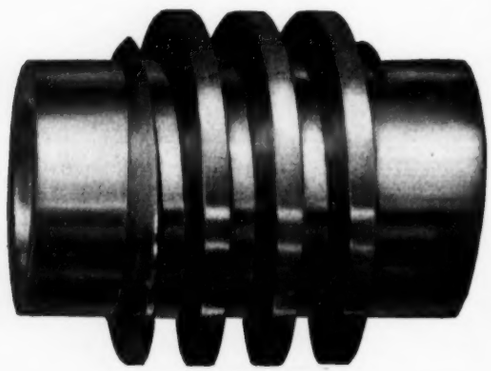
Index to Advertisers and Classified Index Following Reading Matter.

THREAD MILLING MACHINE WORK

The Thread Milling Machine is superseding the lathe for threading. Not only will it do work faster than the lathe, but from two to six thread milling machines may be run by one man, thus reducing the labor cost. The thread milling machine excels in accuracy, finish of work, and economy of operation.

On spiral gears, worms and various miscellaneous pieces, the thread milling machine offers great economies, and on certain classes of this work it is the only tool which can do the work commercially. It will spline long shafts in a fraction of the time required by other types of milling machines.



SINGLE THREAD WORM

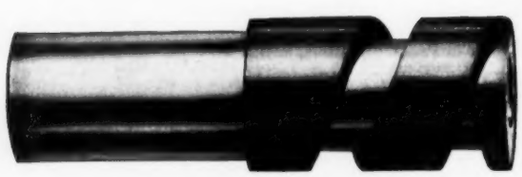
Time, 6 minutes. Diameter, 2 inches; length of thread, 1½ inches

2½-INCH SPIRAL GEAR

Time, 6 minutes. Face, ½ inch; 12 teeth; lead, 4 inches

SEVEN-TOOTH SPIRAL GEAR

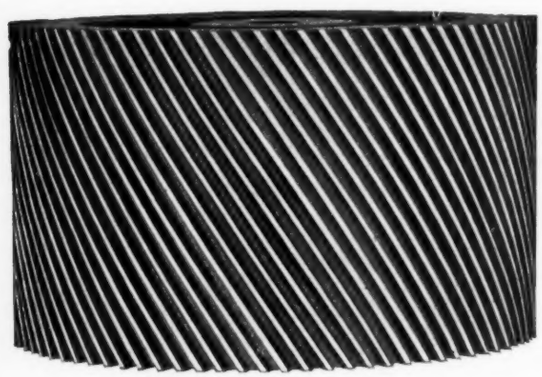
Time, 4 minutes. Diameter, ⅝ inch; length, ⅛ inch



PART FOR AUTOMOBILE STEERING GEAR

Time, 1½ minutes. Length of thread, 1½ inches; diameter, ⅞ inch; lead, ¾ inch

Piece in center is a Flexible Shaft, 1 inch diameter, 12⅞ inches long, quadruple thread



6 3/16"

6 3/16-INCH SPIRAL GEAR

Time, 90 minutes. Length, 3¾ inches; 82 teeth; lead, 30 inches

FIVE-TOOTH SPIRAL GEAR

Time, 6 minutes. Diameter, 7/16 inch; length of thread, 1¼ inches

TOOL-POST SLIDE SCREW FOR ENGINE LATHE

Time, 20 minutes. Length of thread, 5½ inches; diameter, ½ inch
Eight threads to the inch, acme standard

One man can run four machines on this work, producing in this way a screw every five minutes

PART FOR AUTOMOBILE STEERING GEAR

Time for double thread, 7 minutes. Length of thread, 2 inches; diameter, 1 5/16 inches; lead, 1⅝ inches

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TRINITY BUILDING, 111 BROADWAY, NEW YORK. **WORKS, HARTFORD, CONN., U.S.A.**

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Modern Pipe Founding.

EDITORIAL CORRESPONDENCE.

To get an adequate idea of a modern industry one must go to a primary market where all streams of commerce converge, and when one does this the result, regardless of the industry, is pretty apt to be a source of astonishment, at its magnitude. Of no industry is this more true than pipe founding. This feeling begins when looking at the stock piles (see Fig. 1) which meet the eye on entering a pipe foundry; it grows when noting the rate at which additions are made to the accumulated stock and when this is multiplied by the number of similar foundries in the country the feeling becomes one of simple amazement that such an output can be absorbed. Those who have had a life-long connection with this industry tell me that a conservative estimate would place the amount of gray-iron pipe made in this country at 2,000 tons per day.

No industry is more highly organized and systematized and it is, moreover, strenuous to the last degree, there being few more exhilarating sights than a pipe foundry at work. The workmen are chiefly negroes, the sunny good temper of which race is nowhere seen to better advantage. The work is, of course, hot and dirty, and no one who has seen the sustained activity which pipe-foundry workmen maintain from day to day and the cheery willingness with which they do it will ever again have much patience with those who look upon the negro race as slothful and indolent.

The whole interior of a pipe foundry is one bustle of activity, but of all those engaged the man who releases the clamps by which the molds are held together is, perhaps, the star performer. The flasks are of iron, each containing from one to three molds according to the size of pipe. The halves are hinged and are so hung as to open of their own weight and drop their contents. They are prevented from doing this by a series of U-clamps driven over their flanges—three on the lower edge and two on the upper. As the flask is lifted from the pit by the crane and by a bail chain, connected near the middle lengthwise of the flask's length but long enough for it to swing vertically within the bight, a workman stands alongside with a light sledge and before the hoist is completed the two clamps on the hinge side of the flask are off. Perhaps they drop into the pit and perhaps elsewhere, but no matter. The supply is large enough to prevent a few being missed, time is precious and those going into the pit may be recovered later. The loaded mold rises but it does not stop, and as the crane completes the lift the mold tilts to a horizontal position and without pause the crane swings it to the discharge side of the building. Before it gets there, as it passes above the workmen's head, two of the lower clamps have received attention and but one remains to hold the halves of the flask together.

A race between flask and workman to the discharge point of the building follows, but it is a tie. Both arrive there together and simultaneously the tap of a crowbar releases the last clamp and the flask is emptied of its contents—the hot pipe on a pair of ways, by which it rolls down to the dipping tank and testing machine, and the sand accumulating for attention when the day's melt is finished. The flask is scarcely empty before it is again hoisted and swung back, the workman, more likely than not, running one end of his bar under the hinge bolts, grasping the other with his hands and riding with it through the air above his fellows' heads to be dropped with the flask to the floor, where the clamps are replaced and the flask lifted again and swung to another position ready to be rammed up again for a repetition of the operation.

The half-tones which accompany this article were made by the courtesy of those in charge of the Dimmick Pipe Foundry, of Birmingham, Ala.—a foundry which, when extensions, that are now nearly complete, are in operation, will have a capacity of 300 tons per day—and of those in charge of the United States Cast-Iron Pipe & Foundry Company's plant at Chattanooga, Tenn. The remarks made above relate strictly to the Dimmick foundry, where the taking of photographs during working hours is an impossibility and the half-tones from that foundry therefore represent the works in their Sunday aspect. The Chattanooga foundry follows different and unique methods and the taking of photographs there during working hours being feasible, that was done in the present case.

The rigid specifications to which pipe is now made and the exacting nature of the tests for which these specifications call have introduced the chemist and his laboratory as an essential part of a pipe foundry. Pipe is now regularly cast from mixtures of iron, which are made up with a view to the chemical analysis of the product, this mixture being obtained by systematic piling of stock, as indicated in Fig. 2. Each pile of pigs represents a carload which has been numbered, sampled and analyzed and its analysis recorded. There is, however, no weighing of the pigs in making the mixture. The average weight of a pig is easily obtained and is sufficiently uniform to enable satisfactory mixtures to be made by counting the pigs. In making up his carload the workman is therefore instructed to take a given number of pigs from piles of designated numbers.

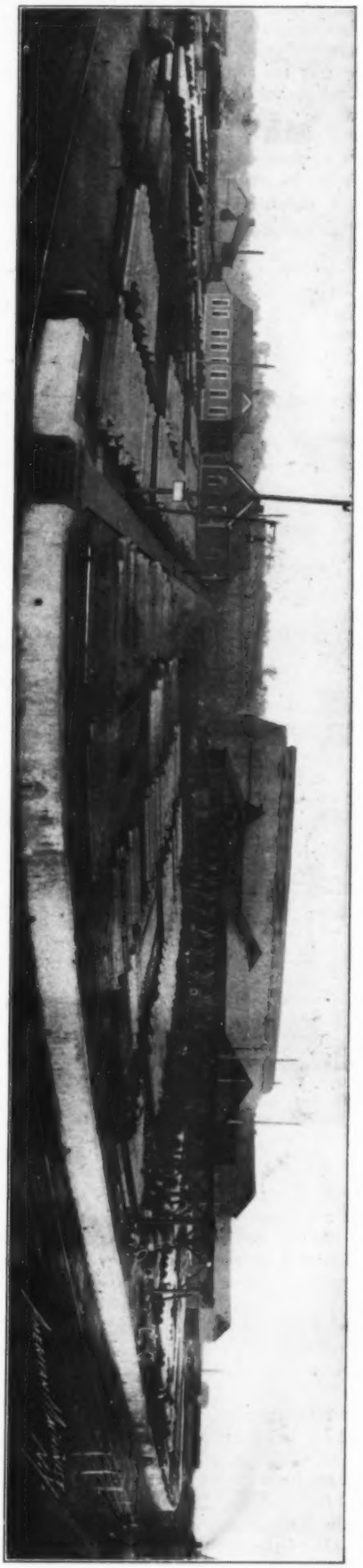


FIG. 1. GENERAL VIEW OF THE DIMMICK PIPE WORKS.

Pipe is always cast on end and, except at the Chattanooga foundry, in a circular pit equipped with jib cranes. Two views of a pit (one of four) at the Dimmick foundry are shown in Figs. 3 and 4, the former showing the condition of things when beginning work in the morning. The pit has a uniform width throughout its circumference, except at one place, shown at the right of Fig. 3, where it is wider, in order to supply space for an accumulation of molds. The molds shown were made the previous day, and as rammed up were deposited in the position shown, where they stand on a furnace with an opening for each one, through which the furnace gases pass to dry the molds—each mold having a perforated plate laid over its top to prevent a too active draft.

At the beginning of operations each morning the molds are removed from the furnace top and placed upright in the narrower part of the pit in the foreground of Figs. 3 and 4, the cores are inserted and the molds made ready for pouring. After pouring, the gymnastic performance, which I have endeavored to describe, is gone through, the discharge point being at the left, where in Fig. 4 the workman is removing the sand accumulated during the previous day. After dumping the pipe and reclamping the flask the latter is placed in the far side of the pit, as shown in Fig. 4, with the patterns in place, where they are again made ready to go on the drying furnace. As shown in both views, each pit has two jib cranes, one of which serves the casting and the other the molding side of the pit. In the enlargement of this foundry, which is now being built, and which is intended for the largest sizes of pipe, the arrangement will be entirely different. The circular form of pit is, in fact, abandoned, the pit being rectangular and served by a traveling crane. The arrangement will also be such as to involve fewer transfers of the molds in the pit.

The making of the cores is also an interesting process and is nearly as active an occupation as the work about the casting pits. It will be shown in connection with the other pictures of the Chattanooga foundry.

Fig. 5 shows the testing machine and the ways down which the pipe rolls from the discharge door at the left of Figs. 3 and 4. On the way to the testing machine the pipe passes the dipping tank, into which it is dipped after heating in an oven provided for the purpose.

At the left of Fig. 5 is a hydraulic press, by which the pipe is squeezed endwise to make water-tight joints at its ends, and at the right is the water main, by which the test pressure is applied. Like everything else, about the place the testing is done with great celerity—a minute or so sufficing to place a pipe in position, test it and pass it on for its successor. Water-tight joints are made at the ends by thick gaskets of hard wood, which are interposed between the face-plates and the pipe ends. There is no preparation of the pipe ends, the rough surfaces being forced into the wood gaskets with sufficient force to make tight joints without difficulty.

As has been said there is much less bustle and activity at the Chattanooga foundry, but the pipes go rolling down to the testing machine with the same unfailing regularity nevertheless. When making pipe of the size in progress in Fig. 6, of which two pieces are cast in each flask, the output requires the opening of a flask once in six minutes throughout the working day.

The methods of this foundry are found in no other and are due to Mr. D. Giles, who has been connected with it for many years. There is here no pit, but in its place a turntable on which the flasks are mounted before ramming, and from which they are not removed until after pouring. With this central idea goes an entire rearrangement of the crane system and a mechanical rammer.

Fig. 6 will give an idea of the turntable, in suitable recesses of which the flasks are secured. The turntable is always full, an empty flask being placed in position as a full one is removed, the

FIG. 2. STOCK PILES OF THE DIMMICK PIPE FOUNDRY.

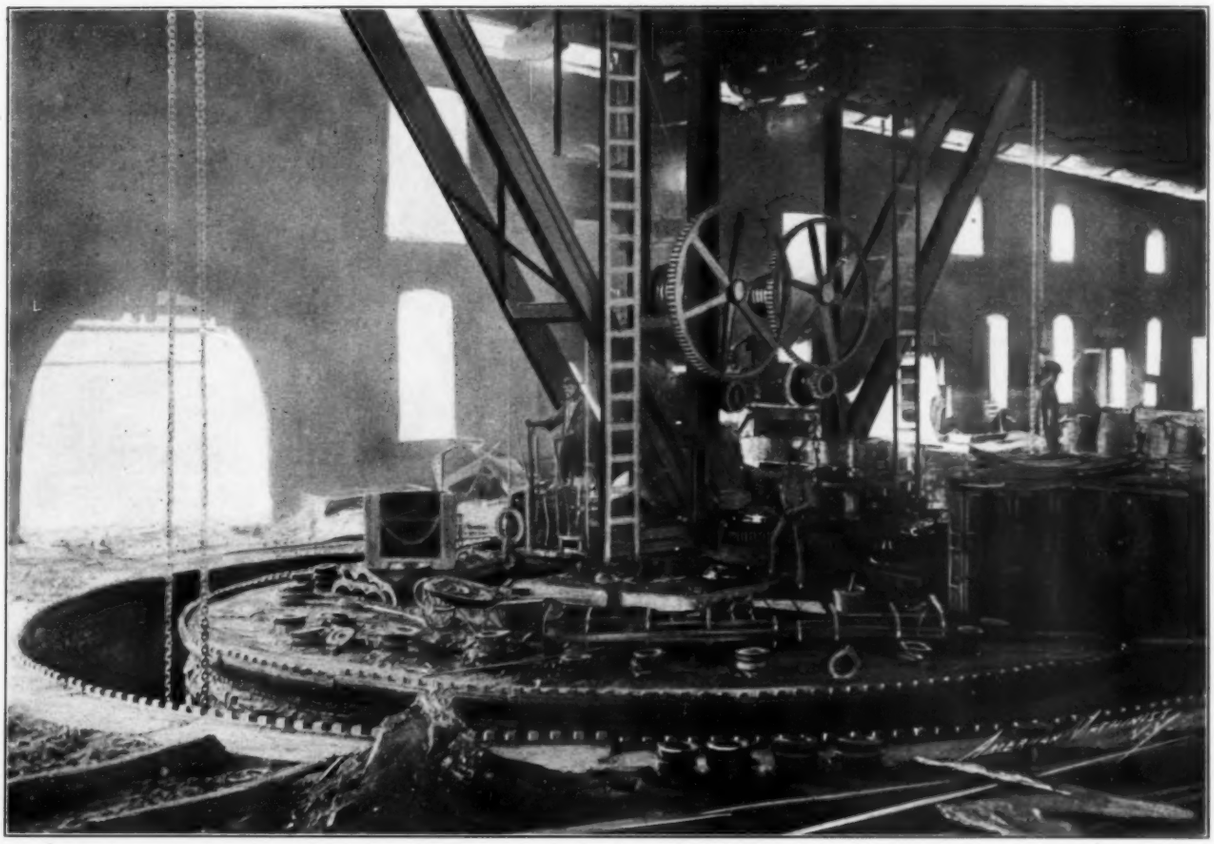


FIG. 3. CASTING PIT OF THE DIMMICK PIPE FOUNDRY.

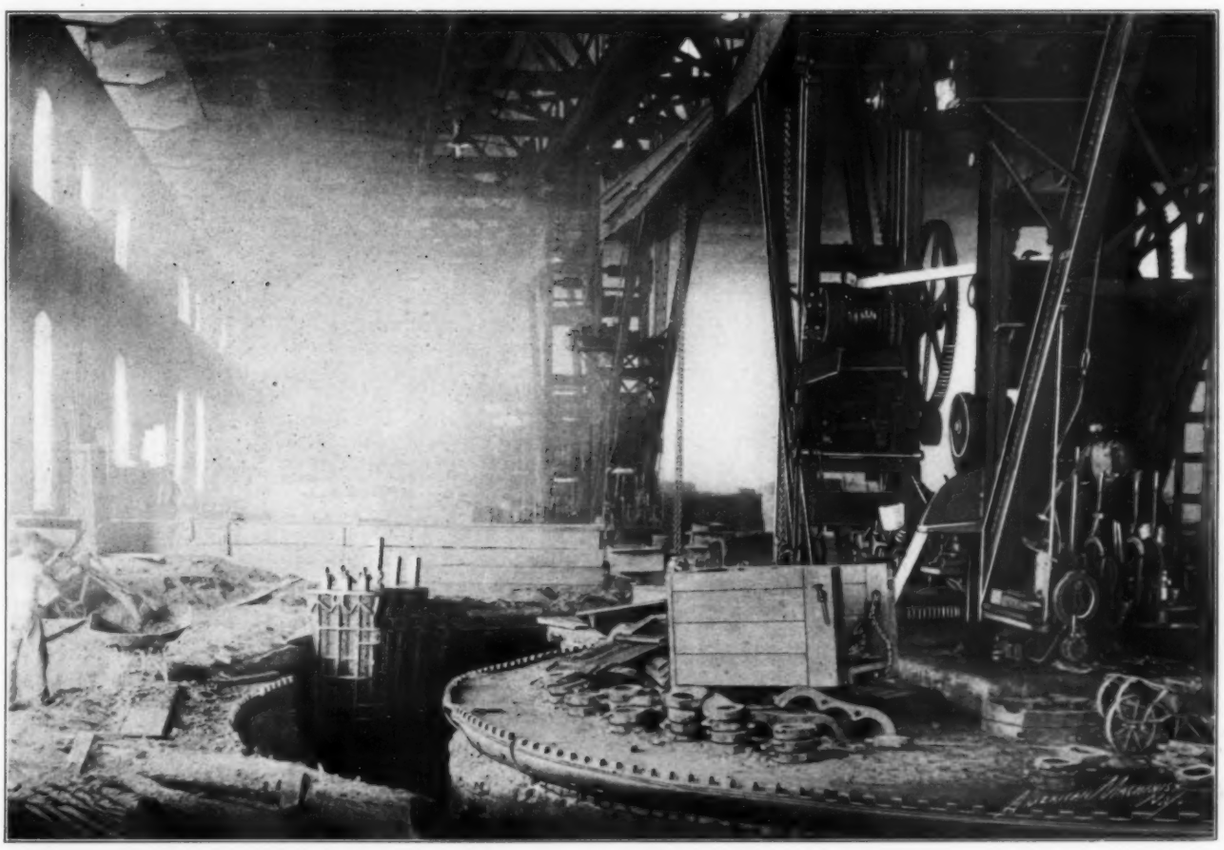


FIG. 4. CASTING PIT OF THE DIMMICK PIPE FOUNDRY.

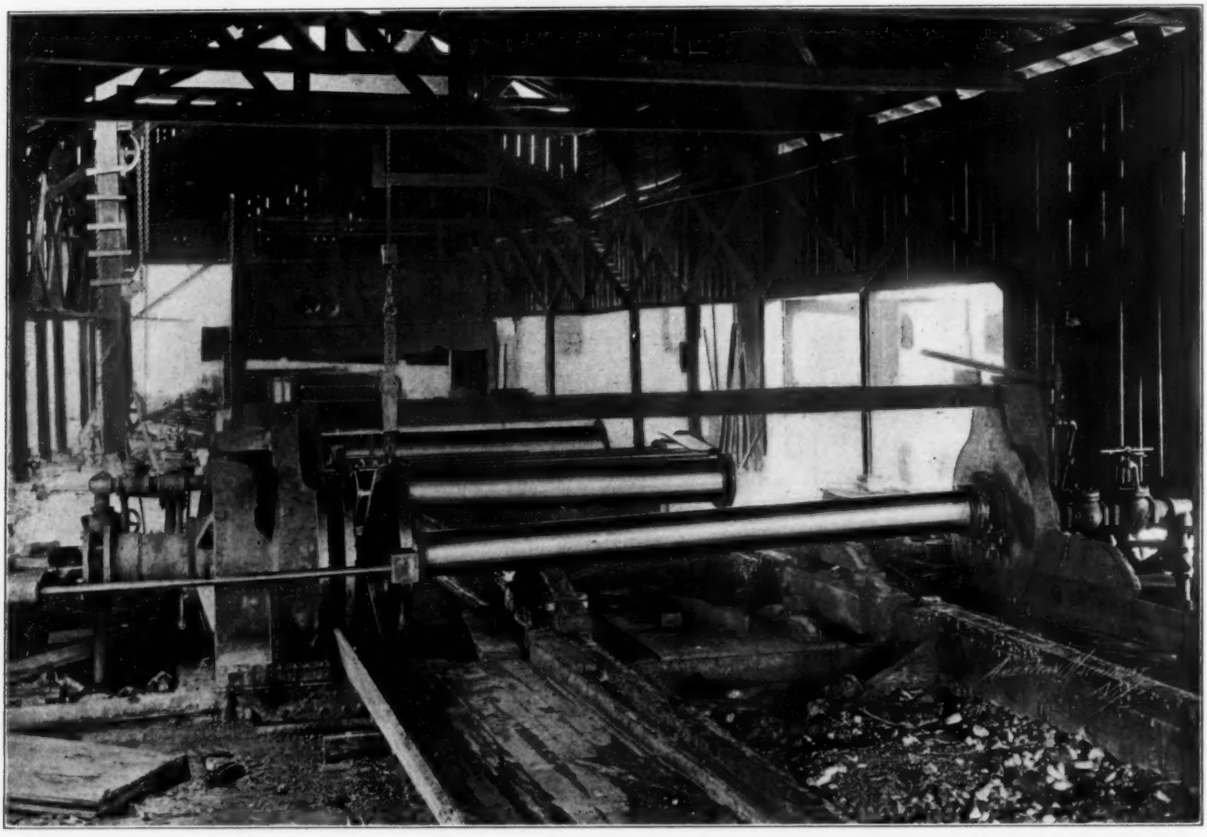


FIG. 5. HYDRAULIC TESTING MACHINE.

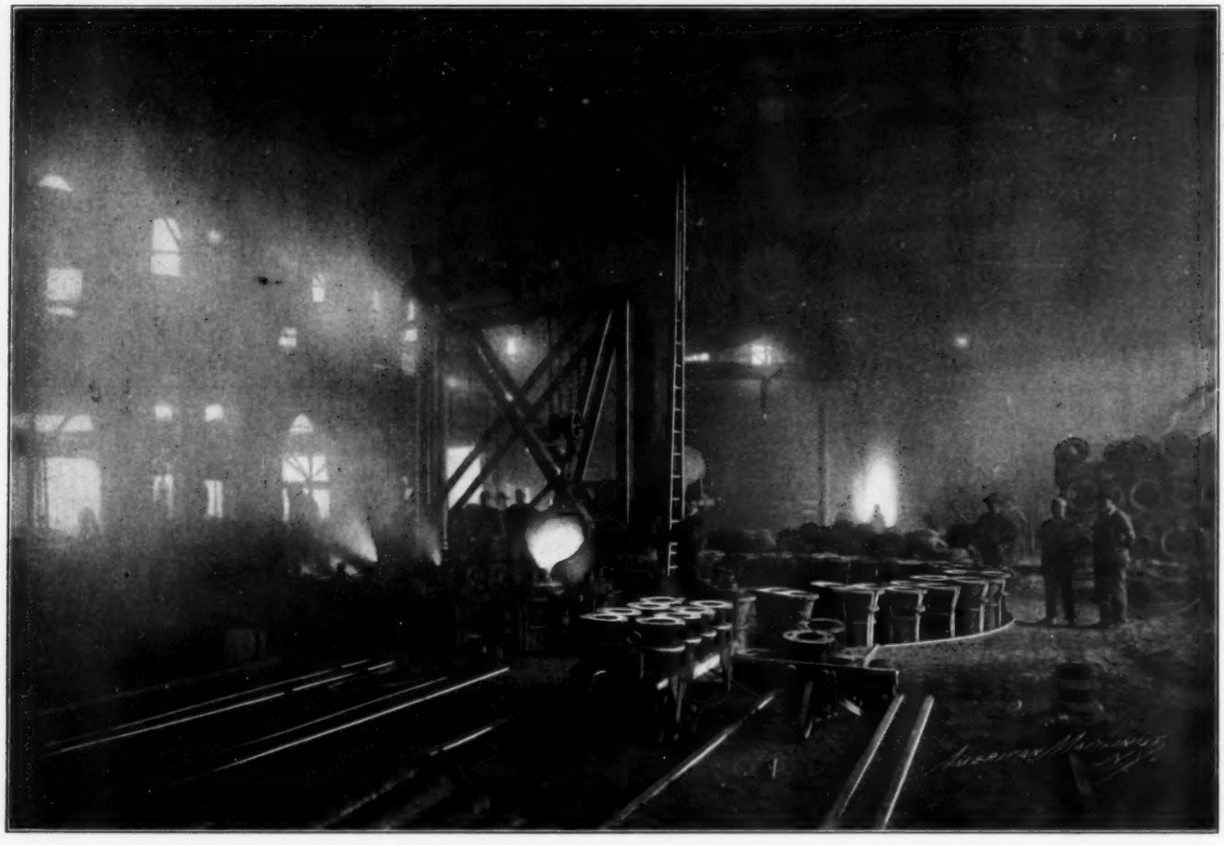


FIG. 6. POURING PIPE AT THE CHATTANOOGA FOUNDRY.

operation of molding, drying and pouring going on simultaneously in different parts of the circle. The molds at the left have been poured, those in the middle are ready for pouring and those at the right are ready for inserting the cover.

A furnace for drying the molds is located below the turntable and occupies a part of its circumference between the molding and pouring portions. From time to time the apparatus is turned about its axis by a capstan wheel, not shown, the stop being made in all cases with the molds located directly over openings in the top of the furnace. Perforated plates to hold back the heat are placed over them as shown in Fig. 7.

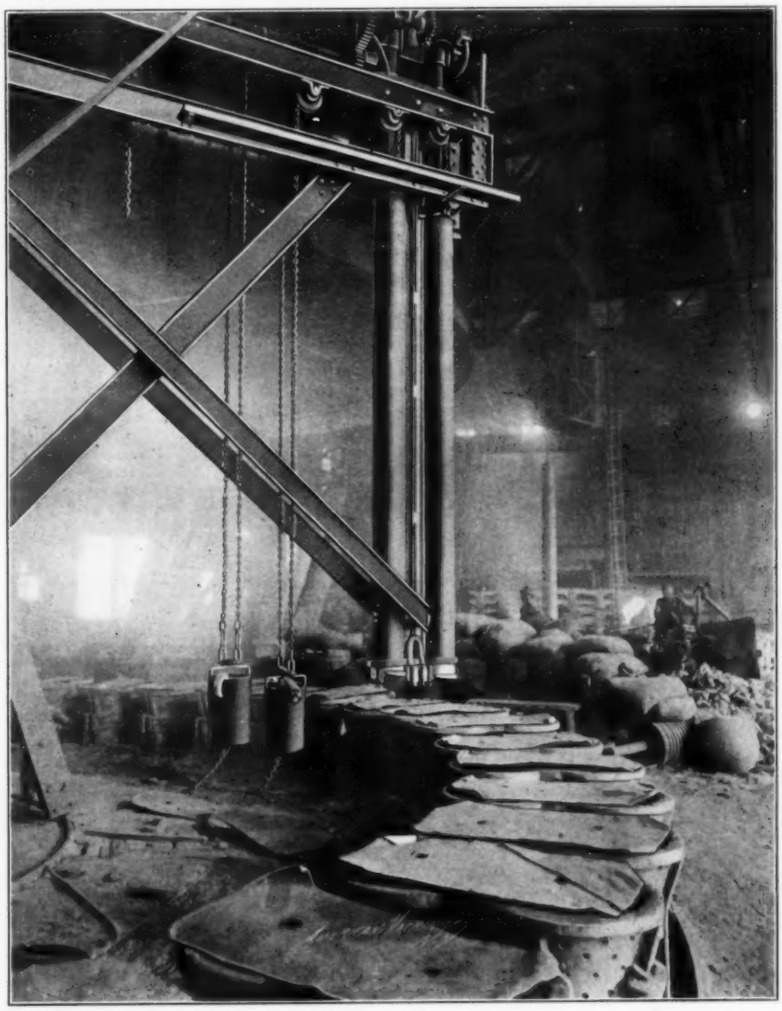


FIG. 7. THE MECHANICAL RAMMER.

The iron frame shown in Fig. 6 is swiveled at the center of the turntable and might at first glance be taken for a jib crane. It is not such, however, but a frame for carrying one of the most novel features of this foundry—the mechanical rammer for the molds. This device is shown more fully in Fig. 7, in which, in order to photograph it, the rammer has been swung away from the molding portion of the turntable to the drying portion.

The rammer, which is double, to adapt it to the double flasks, consists of a pair of tubes with thickened, screw-shaped ends. The tubes are driven by square shafts running down through them, and are counterweighted by the balance weights shown near them — the counterweights having removable portions which, when removed, leave an excess of weight in the tubes. When a pair of molds is to be rammed the patterns are inserted and the rammers are run down over them. Sand is then shoveled in around the tubes and they are set in motion by an electric motor which drives them from above through the square shafts. The action of the screw-shaped ends is to compress the sand and to screw the rammers upward, this action continuing as sand is added until in a surprisingly short space of time the mold is finished.

The crane system is not well shown in these views, because of the inevitable smoke which is always present. The jib form of crane is entirely abandoned, and in its stead is a series of cranes which may be described as swinging travelers, one end of each crane girder being hung from the roof on a swivel, while the other travels on a semicircular suspended track. Each turntable has two such cranes, one for placing the empty flasks in position on the turntable and for removing the poured molds therefrom, and the other for dropping the cores into the molds and for handling the ladle, as it is doing in Fig. 6. The circular track of the former crane is seen suspended from the roof at the left in Fig. 6, and the girder of the latter may be identified by tracing the chain from the ladle. The swivel of the former is located at the left side of the building, over the door through which the pipe is discharged, while the swivel of the latter is over the center of the turntable, where also is the operator's cage. The circular track sweeps from this point as a center to nearly the right side of the building, along which is a straight trolley track by which the ladles are brought from the cupolas and delivered to whichever turntable may need them.

The cores are built up of loam, which is applied to core barrels by means of lathes, a thickness of hay-rope being first wrapped around the barrels in the same lathe. Figs. 8 and 9 show the form of lathe used, the former being from the Dimmick and the latter from the Chattanooga foundry. They do not differ essentially. Fig. 9 shows the core in the act of making, the workman at the left manipulating the hay rope, and the one at the right applying the loam. Two bales of rope will be seen at the right, the rope being wound on as a double-thread screw. The rope is closely followed by the loam —more closely, in fact, than in the picture—the completion of the two operations being practically simultaneous. A supply of loam is placed on the plate shown most clearly, though without the loam, in Fig. 8, the workman applying it with his hands and the surplus being scraped off by the edge of the plate. The loam is applied in two coats—a roughing and a finishing coat, with a drying between. After the second coat is applied, the core is blackened in the same lathe and the core is again dried, a core oven with the buggies being shown in the background of each illustration. The core-making is as active a process as all the others about the works. I timed the making of several 8-inch cores, and the time of the roughing operation did not exceed two minutes, while the finishing operation, including blackening, was scarcely as long.

The facilities for handling the cores are, of course, complete. A buggy stands on one of the tracks alongside the lathe, and counterweighted ropes provide for transferring the cores from lathe and buggy and from buggy to lathe in a twinkling.

The making of the hay rope is shown in Fig. 10. The rope is twisted and completed as it passes the operator's hand, an

epicyclic train of gears winding the completed rope into a bale on the drum. A brake controlled by the operator's foot determines the speed of winding. The machines run at a high rate of speed, and the operator's thoughts have no time to go wool-gathering. F. A. H.

American Goods Better Packed than English.

A recent issue of the *British Trade Review* calls attention to the fact that goods going out of the United States into foreign ports are by no means so badly packed as some people would have the public believe. In pointing out existing evils affecting British trade the *Review* says:

"Sufficient attention is not given to the necessity of packing in a small compass. For transmission to a distant colony this is important, because the smaller the cubic measurement in which the goods can be packed the less is the freight, storage, cartage, wharfage and sometimes duty.

"American goods, and sometimes German goods, are more closely packed than British goods, without in any way increasing the risk of breakage or damage. Whenever a duty by measurement has been placed on any article in Victoria it has been found that the Americans, and sometimes the Germans, have proved themselves able to place a greater quantity in a cubic foot than the British. The trade in lamp glasses, bottles and some other items has been seriously affected by the difference in the closeness of the packing.

"A feature of United States packing is the more general practice of making up articles into trade packages—that is, into packages which can be bought and sold in the cases in which they are imported. Clocks, lamps and many such articles are sent in cases of unvarying size and containing a suitable number of articles for sale to retail shopkeepers, when similar goods from the Continent or from Great Britain would be sent in larger cases of irregular size, designed for no other purpose than to convey the goods to Melbourne. Further, the United States use largely specially prepared pitch paper for lining cases, where the British use metal.

"In the boxing or 'get-up' of small goods the United States manufacturers excel. They use cardboard boxes in numerous instances where the British pack in brown paper parcels, and the United States practice is held to be preferable, for the reason that the box is suitable for placing on the shelves of a shop. As regards the goods which are packed in boxes in Great Britain and the United States, the boxing is nearly always better done in the latter country, the boxes being stronger and more sightly. British goods can commonly be picked out in the stock of a hardware store by the greater number of broken boxes. The excellence of the manila paper and cardboard boxes used in the United States has been a considerable factor in advancing American trade."—*The Manufacturer.*

The Largest Coal Breaker.

What is said to be the world's biggest coal breaker has been recently completed by the Delaware, Lackawanna & Western Company, near Wilkes-Barre, Pa. It is not only the largest coal breaker, but there are several innovations in its construction, as all coal under the grate size will be picked by mechanical coal pickers, so that the breaker boys will be dispensed with. The breaker is lighted throughout by electricity to reduce the risk of fire, and all the machinery is driven by electricity. The maximum capacity of the breaker will be 6,000 tons of coal per day. It was built at a cost of $175,000.

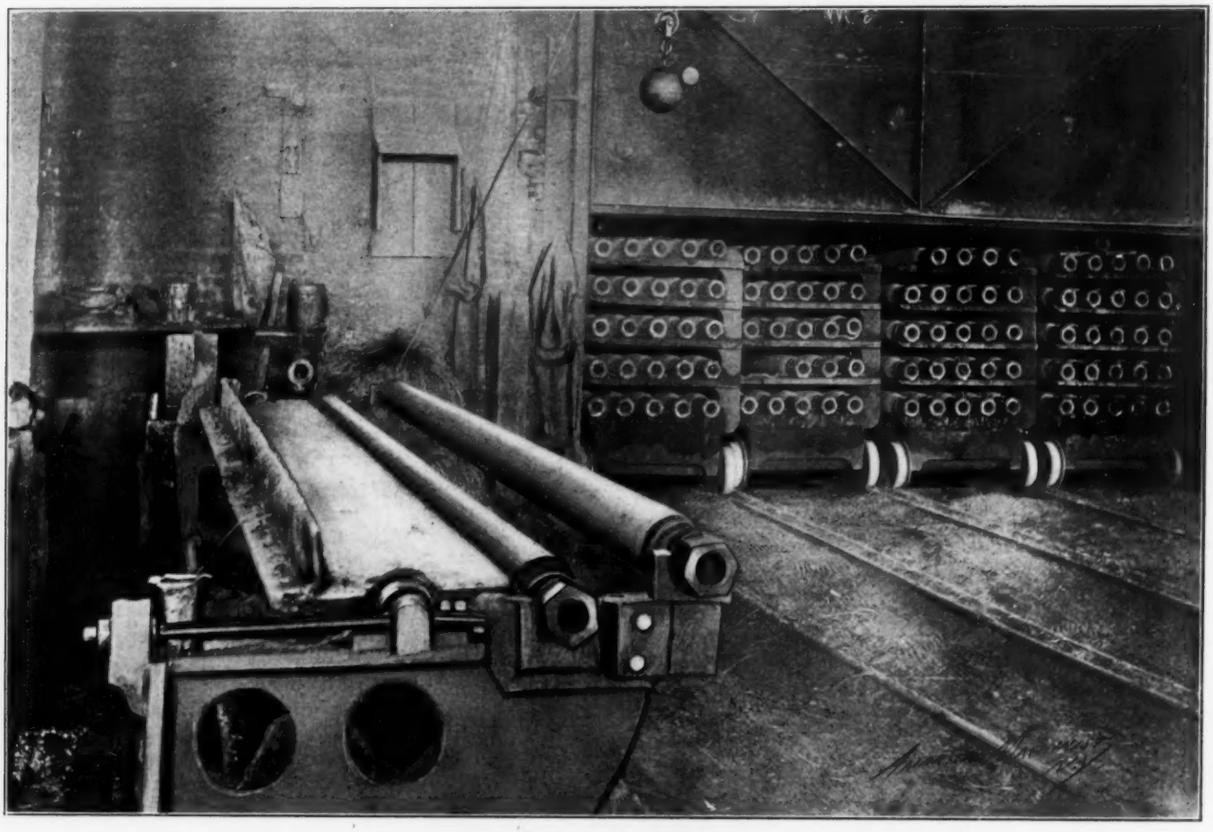


FIG. 8. CORE LATHE.

Now that the noisy workers on the Bridge have worked out from under the superstructure their afternoons are happy—they can see the score by innings. And not only see, but testify their appreciation. When a run is scored by the home teams they applaud with that triumph of modern mechanical genius, the electric riveter.

When the machine is held against a girder and the current thrown on, the racket with which it greets each added run beats all the best efforts of the shouting crowd in the street below.—*The Sun.*

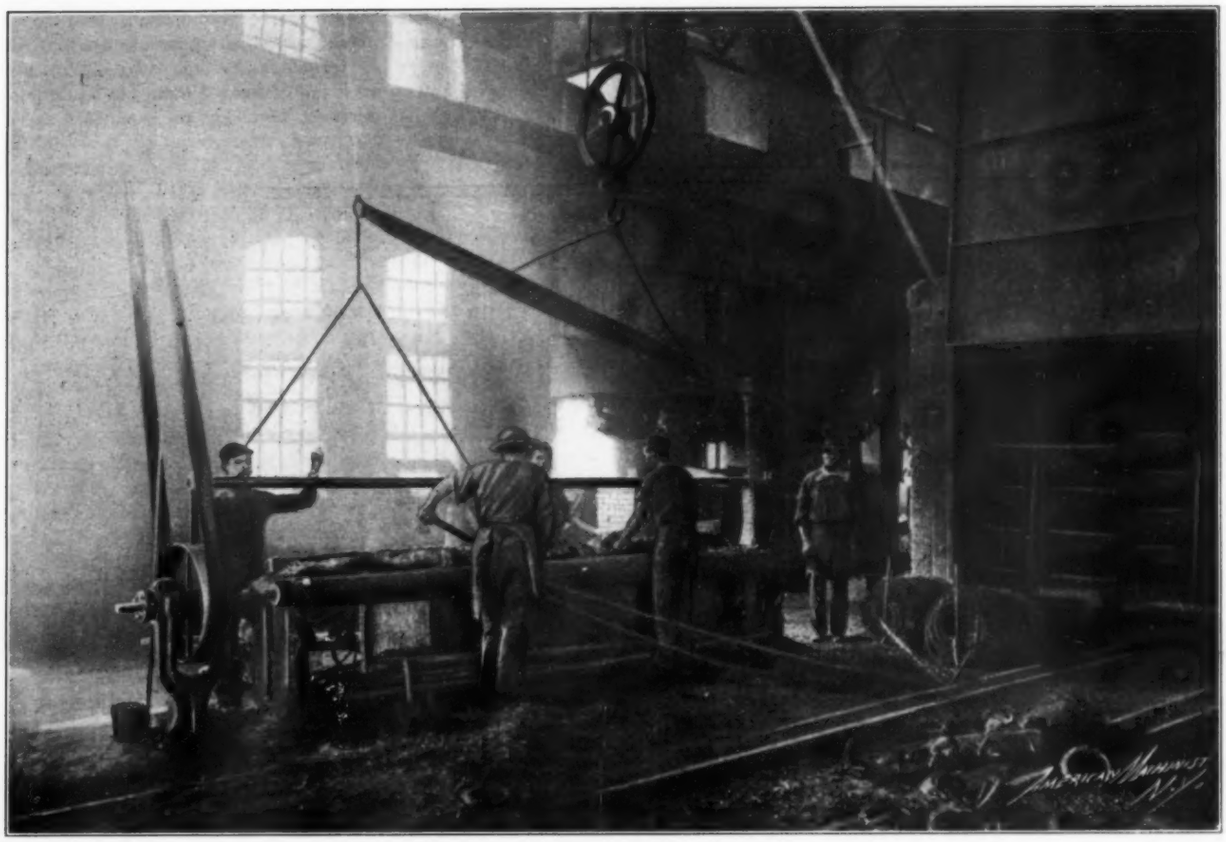


FIG. 9. CORE LATHE AT WORK.

FIG. 10. MAKING HAY ROPE.

Some English Tools.

BY JAMES VOSE.

John Holroyd & Co., Ltd., Milnrow, Manchester, have recently brought out a series of machine tools, designed to reproduce quickly and accurately any predetermined outline. This development in machine-tool design lends itself admirably to the forming of surfaces characterized by sudden and considerable variations of contour. A scroll, or number of scrolls, has been adopted as the medium for guiding a cutting or abrading tool, the tool or work-carrying slides having mounted on them rollers in contact with the scrolls. The principle is equally easily adaptable to grinding, milling, slotting, shaping and other machines in cases where the direction of the feeds needs to be automatically governed.

TIRE-TURNING LATHE.

The line drawings illustrate the application of the device to such work as the turning of railway tires, buffers and axles. Fig. 1 refers to the tire-turning lathe, and includes a plan, a front elevation, an elevation seen from the right end and cross and longitudinal sections. When turning the tires the cutting tool travels from the position indicated in dotted lines in the plan to the position *a*, and during its progress it has imparted to it a motion at right angles to its travel—the motion being described later as the cross travel—in order to produce the required profile. The travel or feed of the tool from left to right is produced by a feed-screw *b* connected to a driving pulley *c*, which derives motion from any convenient source. The feed-screw *b* engages with the main feed nut *d*, specially mounted (as described later) in the main slide *e*, which carries a floating slide *f*, to which a cross travel is imparted by the control scrolls. The tool *a* is carried by an accessory top slide *g*, operated by the screw *h*, for putting the tool in or out of the cut, as usual.

The feed-screw *b* is connected by gear wheels with the scroll shafts *i* and *j*, which carry the control scrolls *k* and *l*. These are in effect spiral cams, the diameter of which at any point determines the position of the tools in the cross traverse. Lying between the control scrolls is a roll *m*, mounted in a bracket on the floating slide *f*. The displacement of the roll *m* as it travels from left to right under the influence of the feed-screw *b* produces direct positive cross travel in the floating slide *f*, and thus effects a corresponding variation in the diameter of the object operated on by the tool. In many profiles this positive cross travel when advancing and retreating is important, since the tool is then held to the work with the same pressure in both directions. In order, however, to obtain a uniform, or practically uniform, rate of feed for the tool in whatever direction it may momentarily be moving, it is necessary to control the feed of the tool from left to right, so that, for example, while operating on the tread or nearly cylindrical portion of the tire it may be fed more rapidly than when it is being simultaneously withdrawn or advanced by the cross travel for the purpose of turning the flange.

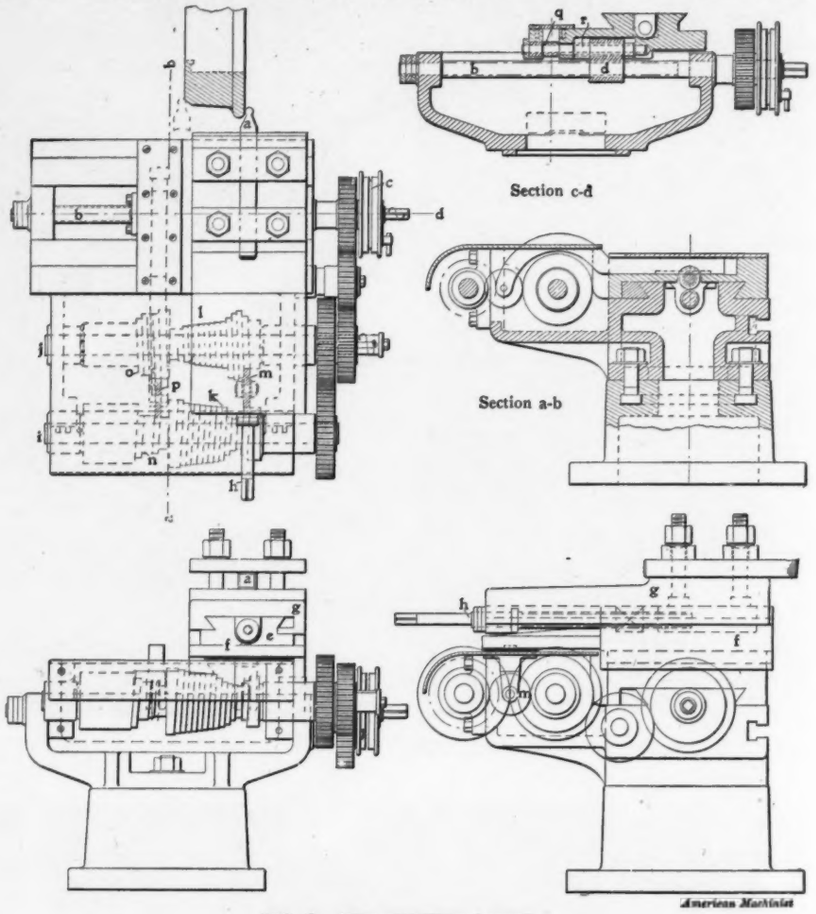


FIG. 1. TIRE-TURNING LATHE.

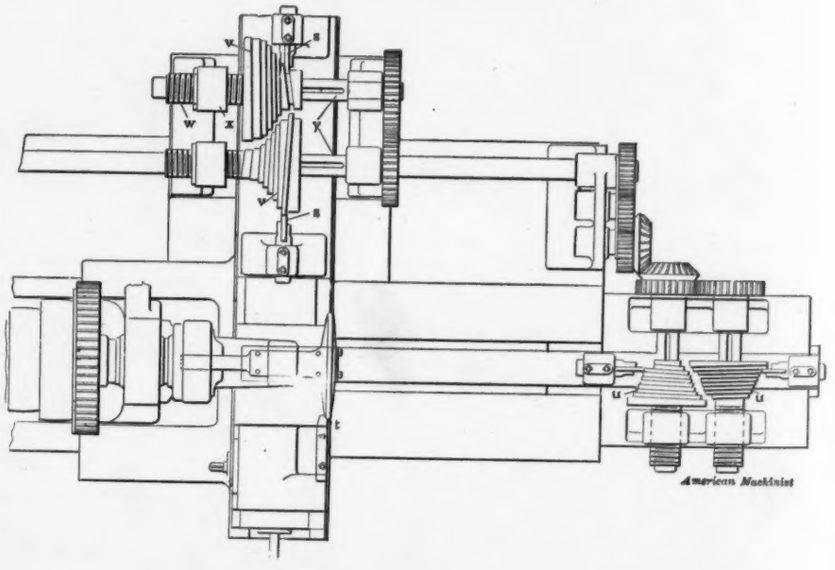


FIG. 2. LATHE ARRANGED FOR MACHINING CAR BUFFERS.

Under such circumstances a second pair of control scrolls *n* and *o*, also mounted on and rotating with the scroll shafts *i* and *j*, are employed. Lying between these is a roll *p*, carried by an arm which is formed as or connected to a rack *q*, meshing with a pinion on an accessory screw *r*, parallel to the main feed-screw *b*. The screw *r* engages with a nut formed integrally with or secured to the main feed nut *d*.

So long as the roll *p* is traveling along a cylindrical part of the control scrolls

n and *o*, the longitudinal feed of the tool *a* is uniform and depends solely on the pitch and speed of the feed-screw *b*. If, however, by a suitable formation of the scrolls the roll *p* is displaced from its mid position while traveling from one point to another, it will operate the pinion on screw *r* and thereby displace the feed nut *d* from its normal position on the feed screw *b* either forward or backward, and thus accelerate or retard the longitudinal feed of the tools. This may readily be effected to any desired extent to suit the contour of the work to be done by giving a corresponding shape to the control scrolls *n* and *o*.

TURNING CAR BUFFERS.

In Fig. 2 a railway buffer is to be operated on, and the advantage of a positive feed in either direction is here accentuated, since considerable pressure has to be exerted, particularly in the cross travel for the back of the buffer, due to the work being nearly flat. Owing to the considerable difference in the diameters at different parts of the scroll it is found best in practice that the two rolls *s* shall engage one with each scroll. The tool *t*, which operates on the back and neck of the buffer, obtains its longitudinal traverse from the control scrolls *u*, connected by a bar to the tool carriage. The cross traverse—at right angles to the axis of rotation—is obtained from the two control scrolls *v*, operating the floating slide, which carries the tool. In this machine the control scrolls *v* are themselves provided with screws *w* of opposite hand or inclination, engaging with nuts *x*, so that as they rotate they also slide along the splined scroll shafts *y*. This construction allows or enables the contour of the scroll to be spread out longitudinally to any desired extent, as compared with stationary scrolls, so as to obtain wide steps or bearing surfaces for the rolls *s* to op-

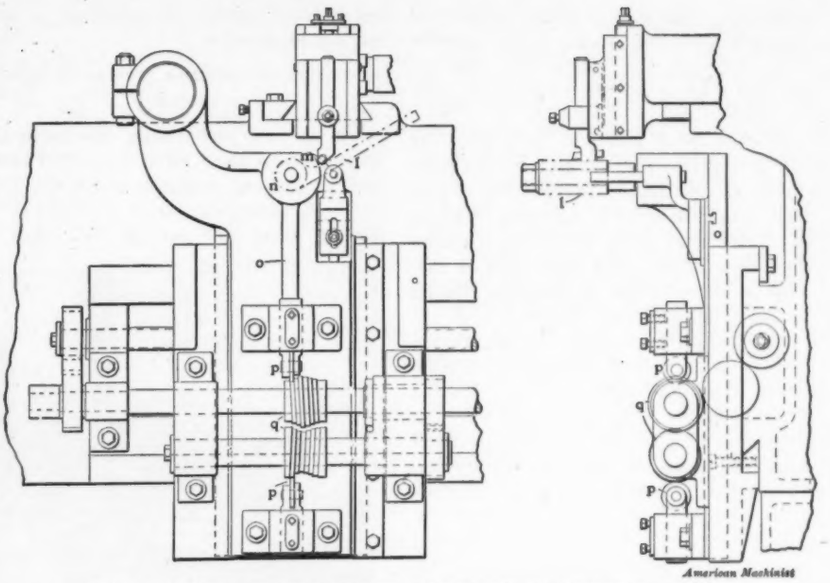


FIG. 4. SHAPER ADAPTED TO THE MACHINING OF IRREGULAR FORMS.

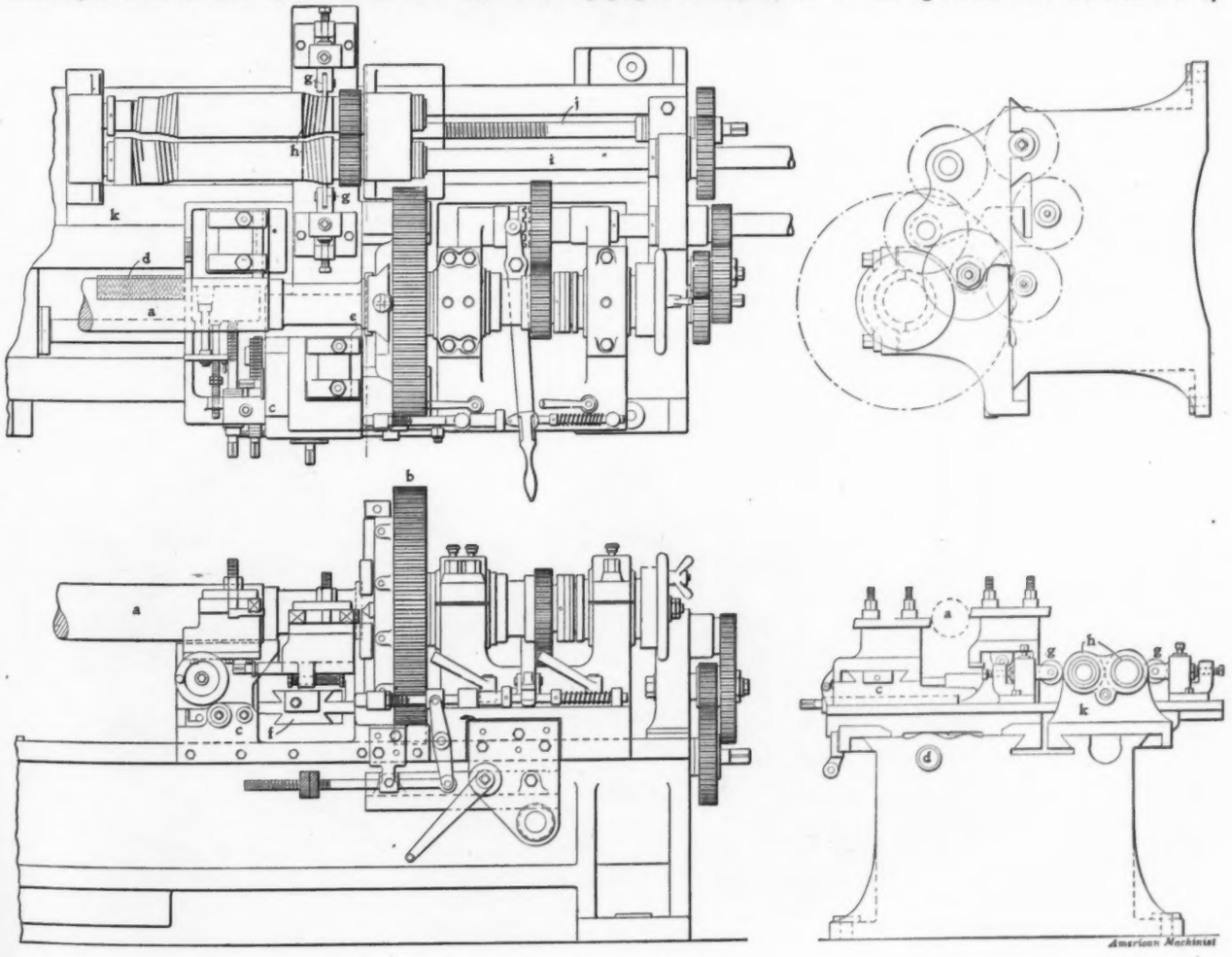


FIG. 3. AXLE LATHE.

erate on. The scrolls *u* are constructed similarly and are made of a suitable shape to vary the longitudinal feed to suit the contour of the back of the buffer head.

When turning axles, as in Fig. 3, the axle *a* is gripped at the end in a suitable chuck on the spindle of the lathe which derives motion from a spur gear *b* keyed on it, this gear being driven by a pinion from underneath. The main slide or carriage *c* receives its longitudinal sliding motion from the main feed-screw *d*.

The tool *e* is mounted on a floating cross slide *f*, which derives its motion direct from the rolls *g*, carried by the floating slide. As mentioned in the previous cases, the control scrolls *h* are equal and opposite and geared together. They derive rotary motion from the shaft *i*, driven from the spindle through the system of gear wheels indicated in the end view. The same system of gearing also drives the feed-screw *d* and the back screw *j*. The control scrolls *h* are mounted in a carriage *k*, provided with a nut engaging with the back screw *j*. The purpose of this arrangement is to impart (as in the case of the machine illustrated in Fig. 2) a translatory motion to the control scrolls *h*. By so proportioning the gearing connecting the back screw with the spindle, the driving shaft *i* and the feed-screw *d*, any desired longitudinal movement of the scrolls as compared with the tool may be obtained. In the example shown, the relative movement is such that the steps of the scroll—and the total length of the scroll—are twice that of the part of the axle to be machined. In passing it may be remarked that as the steps of the scrolls may easily be made equivalent to 30 times the length of the object to be machined, the smoothness of working of the machine so governed is very marked in practice.

APPLICATION OF CONTROL SCROLLS TO SHAPER DESIGN.

Fig. 4 diagrammatically illustrates the application of the control scrolls in cases such as shaping machines where the article being operated on is carried by a floating slide, the position of which is governed by the scrolls. The lever *l*, of which the curve *m* is to be shaped to the desired profile, is held in the work-holder *n* and machined by the reciprocating tool in the ordinary way. The work-holder is carried by the vertically-floating slide *o*, provided with rolls *p* in contact with the control scrolls *q*, which are constructed and operated on the same lines as the scrolls previously mentioned. The slide *o* will, of course, be raised or lowered, and the curve *m* determined by the shape of the scrolls.

AXLE-FORMING LATHE.

The half-tones, Figs. 5 and 6, illustrate a specific application of the scroll principle which has given very satisfactory results in the turning—on their bearings and treads—of railway wagon axles. The axle being dealt with is held between centers and driven by a special chuck from each end. The tools operate at each end simultaneously, although independent of each other. The substantially sectioned bed carries two headstocks, geared 15 to 1. Motion is communicated to the spindles from a splined shaft inside the bed.

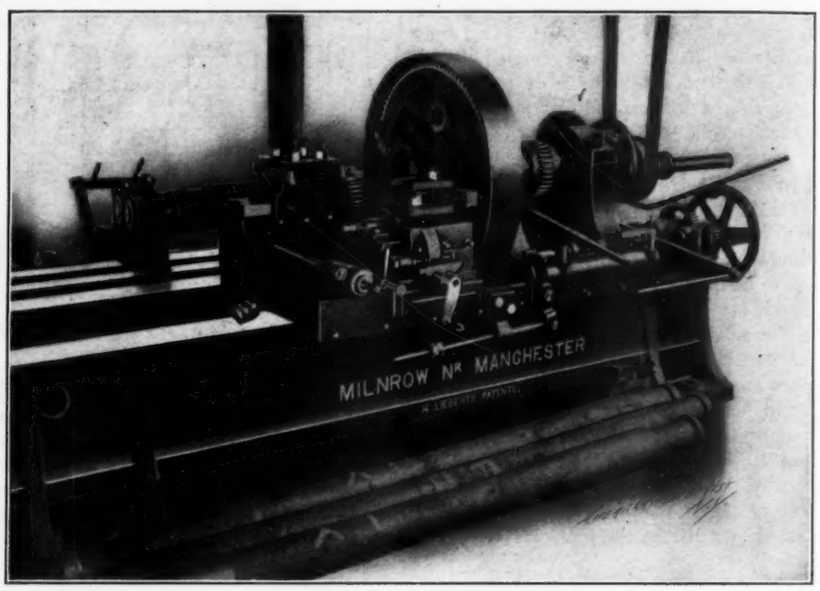


FIG. 6. ONE END OF AXLE LATHE.

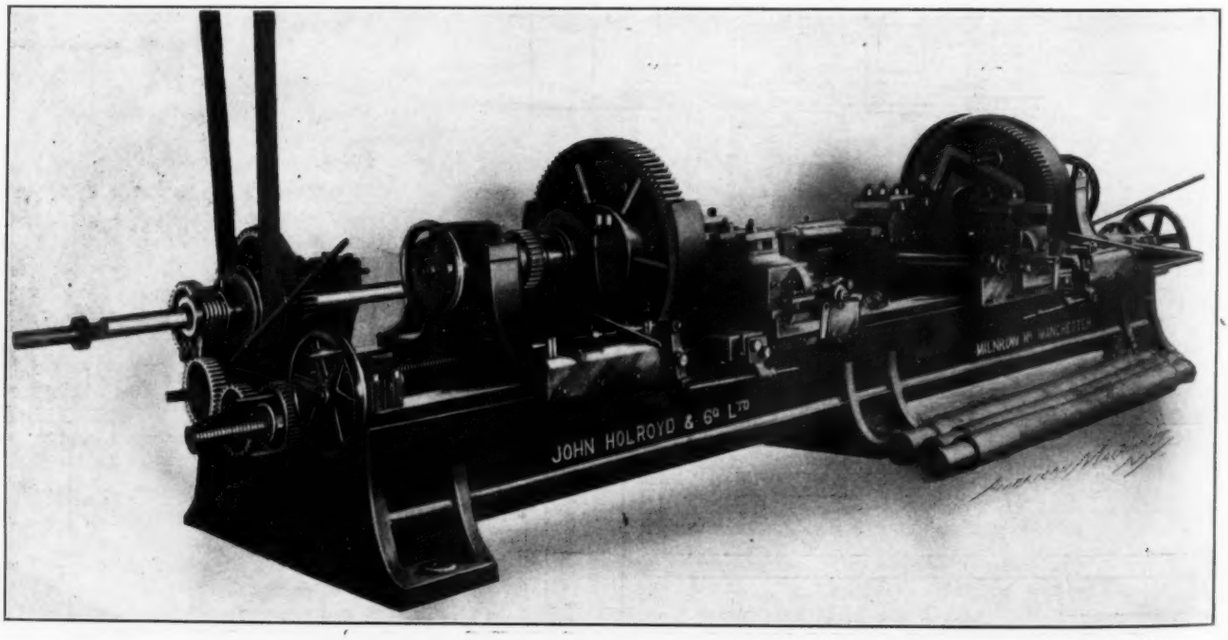


FIG. 5. GENERAL VIEW OF AXLE LATHE.

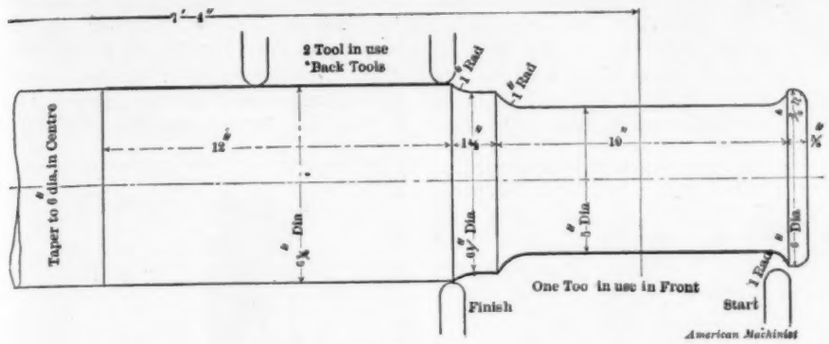


FIG. 7. AXLE.

The spindles have parallel necks running in gun-metal bearings with hardened steel ball thrusts and provision for taking up wear. Each headstock has an adjustable center controlled by a hand wheel at the back end. On the spindle nose of each head is mounted a large driving gear and a chuck for gripping and driving the axle. Each chuck has two hardened steel jaws, each operated by a separate screw, the whole being contained on a loose plate, and fastened to the driving wheel on the lines of a Clements driver, thus insuring accuracy of circle for center. The chucks have inverted serrations, giving sufficient grip for heavy cutting. The two massive saddles carry the carriages or former slides which move in obedience to the scrolls. The former slides carry the front upper slides and tool posts which have longitudinal and traverse adjustments by screws. The back-tool slides are mounted on the saddles and are independent of the former slides. The back of each saddle is extended to support the former slides, on each of which are two adjustable brackets, carrying a hardened steel roll in contact with its respective scroll. The saddle extensions rest on an extra slide or bed cast to the front bed. Mounted on this slide are four brackets supporting the scroll shafts. The scroll slides are traversed in conjunction with the saddles, but in opposite directions, by a steel screw, the feed being obtained from the headstocks. Quick return is provided at the rate of 18 inches per minute. The scrolls are made with reverse profile so that the four rolls, always in contact with their respective scrolls, give a positive transverse motion to the tools in either direction. Four changes of feed are at disposal—8, 12, 16 and 30 cuts per inch. The machine is arranged for driving either by belt or 25-horse-power motor. The usual peripheral cutting speed is 60 to 80 feet per minute. The length of bed is 16 feet, the floor space occupied is 18 feet by 7 feet and the weight 8½ tons. Thirty-five to fifty axles are rough turned per day of 10 hours, the sketch, Fig. 7, giving typical dimensions.

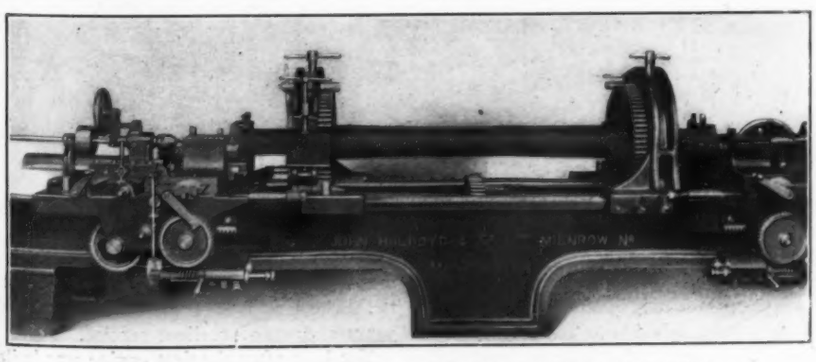


FIG. 8. LATHE FOR CENTERING, FACING AND TURNING AXLE ENDS.

A CENTERING AND FACING MACHINE.

Figs. 8 and 9 represent a lathe designed for drilling the center holes, facing the ends and turning the outsides of the heads or collars of the axles preparatory to their being turned in the lathe previously described. Referring to Fig. 9, the bed *a* carries at each end carriages *b*, provided with suitable tool-holders *c* for drilling the center holes, *d*, for facing the ends, and *e* for turning the outsides of the heads or collars of the axle *A* indicated by dotted lines. Between the end carriages are two rotatable chucks *f*, provided with gear wheels *g* for rotating them simultaneously by means of pinions *h i* from a suitably located driving shaft *j*, which is provided with keys or feathers for rotating the chucks at whatever distance they may be apart. The chucks, which are self-centering, each with jaws operated by right- and left-hand screws *h*, are mounted in casing *l*, adapted to be slid along the bed, and are provided with means for securing them in any desired position to suit different lengths of axles. The chucks and their driving wheels have lateral openings *m*, through which the axles may be placed in the chucks. These lateral openings are usually arranged diametrically opposite each other so that an axle suspended between the chucks from a crane as at *B* may be readily slewed into or out of them. Continuity of driving is maintained by means of two pinions. When the axle is inserted the casing *l* is clamped by a bolt *n*, hinged at one end and threaded at the other, and provided with a nut and handle *o*. The upper part of the clamping bolt fits the vertical slot in the chuck casing. A double-headed

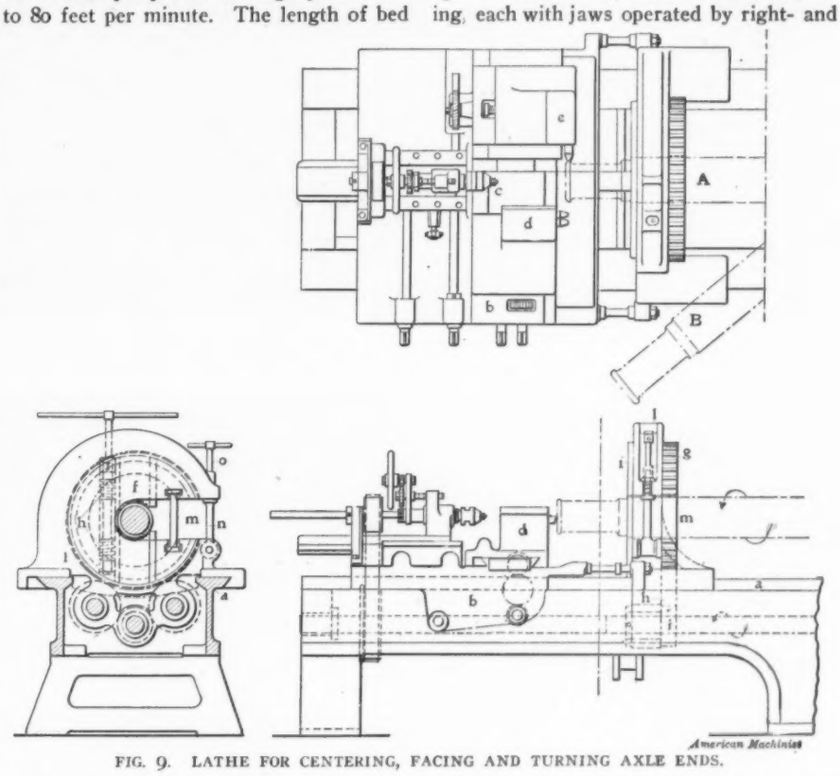


FIG. 9. LATHE FOR CENTERING, FACING AND TURNING AXLE ENDS.

distance piece *p*, inserted in the recess as shown, after the axle has been put in, limits the compression of the chuck, and thus preserves the concentricity of the cylindrical working surface of both chuck casing and chuck. The chucks take hold

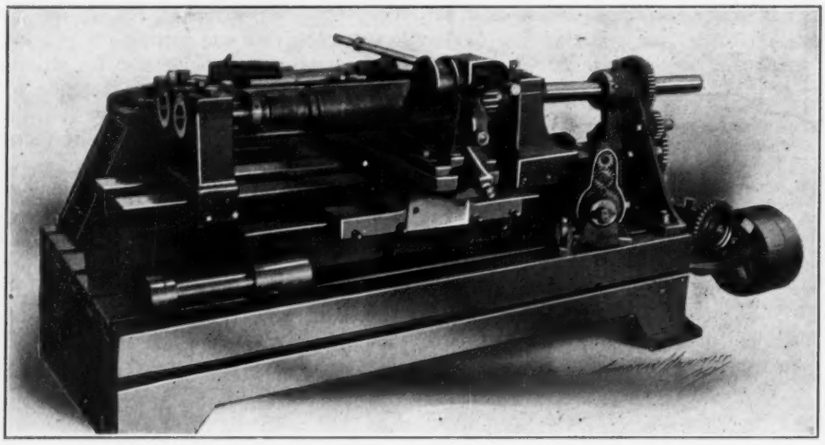


FIG. 10. MACHINE FOR GENERATING SCROLLS FOR AXLE LATHE.

of the axle at the shoulders of the part which enters the hub of the wheel. The method of drilling the center holes and the turning of the collars are self-evident. Automatic stops are provided for the tools, the feeds for which are 17, 24 and 33 cuts per inch. The ratio of driving the wheels is 14½ to 1, and with a bed length of 15 feet 6 inches the floor space required is 17 feet 6 inches by 5 feet, and the weight of the machine is 5½ tons.

SCROLL-GENERATING APPARATUS.

Fig. 10 illustrates a "rig" for generating the scrolls used on the axle-turning lathe. Quite a number of these axle lathes have been supplied to leading railway companies, wagon builders and forges.

Cheshire, England.

Pioneer Engine Building.

EDITORIAL CORRESPONDENCE.

The accompanying illustration, Fig. 1, shows an engine of which the chief interest centers in the difficulties under which it was made. It was the first engine built in Utah and it was constructed at the works of William J. Silver—now the Silver Bros. Iron Works Company. It was put at work November 20, 1868, which is not so long ago, but it must be remembered that at that time the facilities for doing work west of the Rocky Mountains were limited. Gray iron was practically unobtainable, while brass could be obtained in limited quantities, and the castings of this engine were consequently of brass, although, as the picture will show, no unnecessary amount of brass was used. For the making of these castings, Mr. Silver paid $1 a pound—he finding his material, which cost him 25 cents a pound. The result of his supplying his own material was a considerable saving, the going price of brass castings at that time being $1.50 a pound. So far as possible the engine was made of wrought iron, the material for which was obtained from the irons of broken-down wagons, which were then the chief source of supply for such material. The base plate will be seen to be composed of flat plates bolted together, these plates being from the tires of old wagons. The bolts were made from old log-chain links, such chains being the chief source of supply for bolt iron at that time, and when badly worn they sometimes led to curious-looking bolts. These old chains were worth 25 cents a pound. The frame, connecting rod, main shaft and other forgings were forged from old wagon irons. For a flywheel Mr. Silver was so fortunate as to obtain a gear which had been part of a threshing machine, and this gear was used for this purpose without turning off the teeth, gray iron being altogether too valuable a material to waste for mere looks. Alongside this flywheel was a wooden belt pulley. The engine had a 3½ by 7-inch cylinder, and for it Mr. Silver received $600. It was built to drive wood-working machinery.

Fig. 2 is a sketch of the first steamboat on Salt Lake, which was built by General Connor. It was a flat-bottom scow, with pointed ends, the length being 90 feet and the width 30. The machinery for this boat was supplied by Mr. Silver, although he did not build the engine. For this purpose a crank and flywheel steam-pump was to be had, and by disconnecting the water

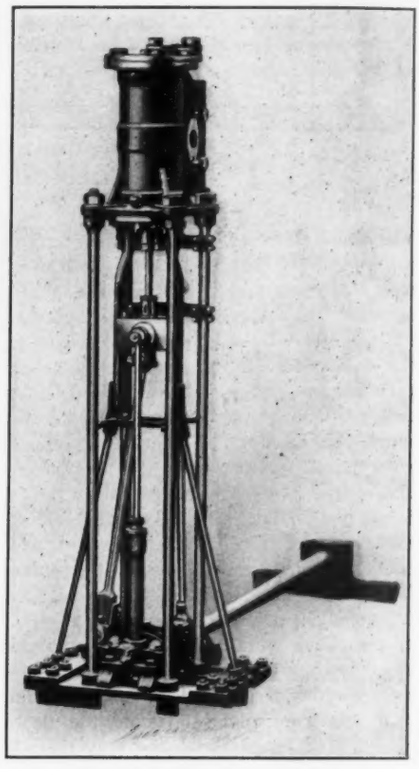


FIG. 1. THE FIRST STEAM ENGINE BUILT IN UTAH.

end and gearing the pump to the paddle-wheel shaft it was made to drive the boat. As an illustration of the paucity of resources at that time, the pump had no

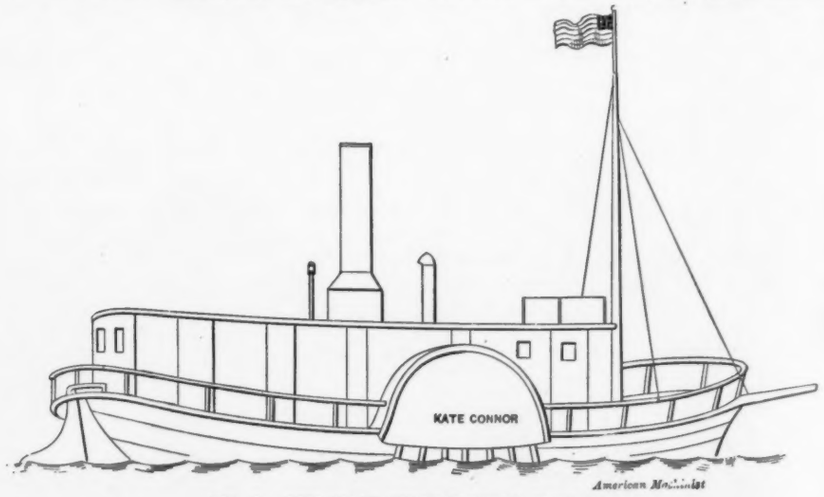


FIG. 2. THE FIRST STEAMBOAT ON SALT LAKE.

globe valve, and such a thing could not be obtained in the Territory. Eventually at 2-inch plug cock was found and this was made to serve the purpose of a throttle. The boat ran on the lake for several years and gave excellent service.

Not long after the first engine was built,

the first merchant iron was brought into Salt Lake City, consisting of a half dozen 5/8 round bars. Mr. Silver immediately purchased all this iron, paying therefor 25 cents a pound, which seems to have been the going price for all kinds of raw material. His first vise cost him $65.

F. A. H.

A Confederate Patent for a Breech-Loading Gun.

BY JOHN S. SWEET.

Having seen the article at page 75 on "Some Mechanical Relics of the Civil War," I am reminded of another relic that seems to be lost in history, yet one of vast importance, and it has raised the question as to who is the original inventor of the breech-loading gun, now made and used by this and other governments for coast defense and naval armament. I enclose an original patent issued by the Confederate government to D. W. Hughes, under date of Feb. 18, 1863, which has been loaned for this purpose by the patentee, Mr. Hughes. It will be observed that guns now made differ from this only in having a screw in place of the lugs shown in these drawings. Fig. 1 shows the breech locked, while Fig. 2 shows the lugs and space for the lug or screw to pass into the nut. *D* shows an elastic gum gas check. Concave metal disks that will expand by pressure are now used, but they are of no material improvement over the gum disk, and expert machinists claim that the screw now used is no improvement over the original lug. The screw must necessarily be of twice the length of the lug to get the same strength and it is much more subject to damage.

The first of these guns were made in 1862 at Memphis, Tenn. A battery of ten was made for Gen. M. Jeff. Thompson, of Missouri, and used in and about New Madrid, and farther south in Arkansas. Quite a number were made at Jackson, Miss., for the State by order of Governor Pettus. Over fifty were made in all, during 1862 and 1863. These guns were of small caliber, 1½- and 2-inch bore, mounted on light carriages and moved by men alone. At a test trial in Memphis, Tenn., in 1862, they were found to carry a round lead ball over three miles up the river. They were from 32 to 36 inches long, some of bronze, and some of broken car axles, and weighed from 65 to 90 pounds, but all experiments showed that the larger the bore the better they were. At the final surrender many of these guns fell into the hands of the Federal Government, as well as the patent records at Richmond. As the Government never made any breech-loading guns until 1880 or 1882, may they not have taken the idea from this patent, or some of the captured guns?

If any one has an older claim we would like to hear from him, as honor, if any, should go to whom it belongs. Mr. Hughes is an old man of seventy-seven, and his address is Yates Center, Kan.

D. W. Hughes' Imp^d Breech Plug

Fig. 1.

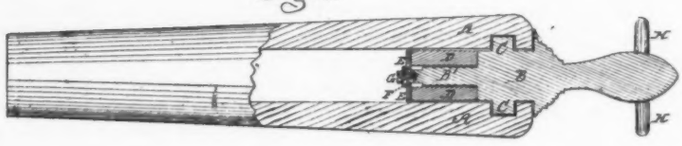
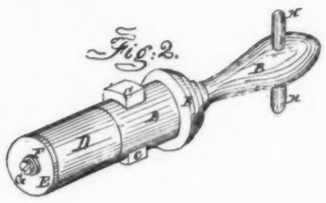


Fig. 2.



Witnesses
A. N. Brannon
M. H. Macmillie

Inventor
D. W. Hughes

No. 149.

THE CONFEDERATE STATES OF AMERICA.

To all to whom these Letters Patent shall come:

Whereas D. W. Hughes of Arizona has alleged that he has invented a new and useful Improvement in Breech Plugs which he does not know or believe was ever known or used before his application; that he is a citizen of the Confederate States; that he does verily believe that he is the original and first inventor or discoverer of the said Improvement and that the same hath not, to the best of his knowledge and belief, been previously known or used; and has paid into the treasury of the Confederate States the sum of Forty dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said Improvement, and praying that a patent may be granted for that purpose.

These are therefore to grant according to law, to the said D. W. Hughes his heirs, administrators or assigns, for the term of Fourteen years from the eighteenth day of February one thousand eight hundred and sixty three the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said Improvement, a description whereof is given in the words of the said D. W. Hughes in the schedule hereunto annexed, and is made a part of these presents.

In Testimony Whereof, I have caused these Letters to be made Patent, and the Seal of the Patent Office has been hereunto affixed.

Given under my hand at the City of Richmond this eighteenth day of February in the year of our Lord one thousand eight hundred and sixty three.

J. H. Walker Secretary.

Countersigned and Sealed with the Seal of the Patent Office.

Rufus R. Chaney Commissioner of Patents.

A CONFEDERATE PATENT.

Up-to-Date Method of Molding.

BY J. K. KING.

The use of the molding machine in the foundry is a question which is puzzling many foundrymen to-day, who, having heard and read of the use of them in some of the large foundries and, moreover, that the machines had been discarded in some cases, and not knowing the cause of these failures, hardly know whether to install them or not. To those in this predica-

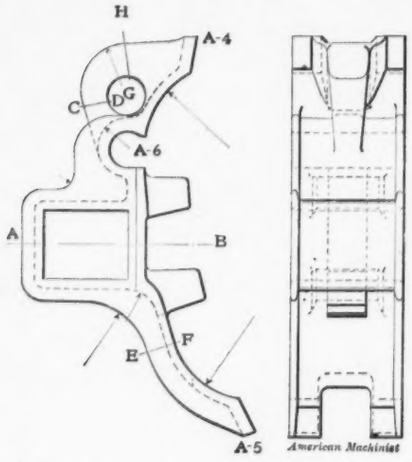


FIG. 1. THE CASTING TO BE MADE.

ment I would quote the old saying, "The proof of the pudding is in the eating of it"; and when preparing it to eat, let them season it with the spice of good common sense, and I will predict that good results will be obtained. The aim of some men is to purchase the cheapest machine they can get hold of, and in nine times out of ten they regret it, for the cheap machine never is a money-maker for them, and it stands in the corner of the foundry, rusting and decreasing in value each day, till at last the foreman throws it in the cupola to get rid of it, pronouncing his benediction on molding machines in general. Other foundrymen will be met with who appear to be more plentifully supplied with money than brains; they will purchase a very expensive machine and hand it over to the foundry to be managed by some unskilled man who might make a better farmer than a mechanic. The results obtained from this machine are not at all in proportion to the expenditure, until at last the boss, disgusted with its showing, orders all work stopped on it, and he sends an advertisement to the foundry magazine "For Sale" column: "A good molding machine, practically new, for sale." There are to my knowledge several foundries now using molding machines with little better results than the two cases just mentioned, yet not within 25 per cent. of what they ought to be. In most of these cases the lack of success may be traced to the opposition of the men, who in one way or another attempt to resist the output of the machines.

THE INTRODUCTION OF MOLDING MACHINES INTO A FOUNDRY.

The right way to go in for the molding machine is by setting a section of the foundry aside for the machine work, or, better still, if possible, to build a separate foundry for this work, the only relation it is to have with the old foundry being the receiving of the iron from the old cupola, and the old molders should be given to understand that they have no business in there. The machines should be set in after the floor is carefully leveled; meanwhile the firm should look around for a capable machine operator and engage him, and under the operator's care the machines should be run by laborers, who can, as a general rule, be picked from the different branches of the plant, the steadiest and strongest men being selected. They are generally willing to take these jobs, as they believe it will mean more money to them, which it should when they are well broken in. They should be put on piece work and encouraged to put up a large amount of work, plenty of help being furnished them for pouring the work, and the iron being brought to them on their own floor.

PREPARATION OF THE MACHINES.

A point demanding close attention is the mounting of the patterns. Each pattern should be closely studied by one skilled in the art, and then carefully mounted on the machine, all precautions being taken, when mounting the pattern, to prevent any trouble in molding. The most correct method of mounting patterns on molding machines is what is termed the stripping-plate method, where the pattern is stripped from the sand by a stripping plate or strippers; with some makes of machines the pattern drops down through the plate, while with others the pattern remains stationary while the strippers, the flask and the sand lift up free from the pattern.

A DEFINITE EXAMPLE.

The pattern in the cut, Fig. 1, is shown mounted on the drop-pattern method, which is most usually adopted on a crooked pattern and where concave and convex plates are used. I will endeavor to describe how this pattern should be successfully mounted, and also show a way it might be mounted, giving poorer results, with the reason therefor.

Fig. 1 represents the casting to be mounted.

Fig. 2 represents the cope section of the pattern mounted on the cope machine, showing the stools and plates in section.

Fig. 3 shows the drag section of the pattern mounted on the drag machine, with the outlines of the pattern in dotted lines, also the building-up pieces, the stools or pattern supports and the core-prints.

Fig. 4 is the plan of the drag stripping plate, with the patterns protruding through it.

Fig. 5 is the plan of the cope stripping plate, with the strippers, the small section of the patterns and the running gate in place.

Fig. 6 is a sectional view of the cope and drag stripping plates together for babbitting purposes.

THE COPE MOUNTING.

The first thing to determine is the parting line; when this is determined, proceed to mount the pattern, part on one plate and the remainder on another plate. The sections of the patterns *A2* and *A3* are so designed that it will be necessary to tip the pattern up on one end to bring the draft correct on these lugs. A wood master pattern of the stripping plate *B*, Fig. 2, should be made, and on it should be located, from the center line of the plate, two patterns, as shown in the plan view in Fig. 4. It is always advisable to make these stripping plates very stiff to provide against springing after being finished. This pattern being so constructed that a deep pocket comes in this plate, it becomes necessary to lift the parting line or the flask line up 2 inches above the top of the machine. The end of the pattern at *A4*, in Fig. 1, is set on a line with the flask line, while point *A5* is dropped 1½ inches below the flask line; this makes a deep pocket in the cope plate, when the plate and the pattern are set in place on the machine. (See Fig. 2.)

A, in Fig. 2, represents the pattern and the pattern plate combined in one; its dis-

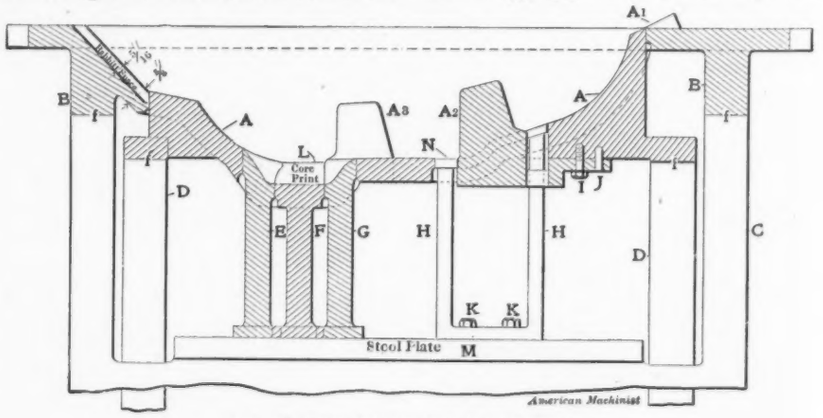


FIG. 2. THE COPE SECTION MOUNTED.

tinctive shape is brought about by the shape of the pattern and the location of the pattern-plate support *D* of the machine, with reference to the top surface of the stripping plate *B*. A master pattern should be made of the pattern *A*, allowing a file finish on the surface that represents the pattern outline, while on the under surface that rests on the machine pattern support *D* allow a large finish so that there will be no difficulty in bringing the plate to its proper size; the metal through the center of the plate is ⅝ inch thick at its thinnest points, and the length of the plate is just sufficient to reach from *D* to *D*, while the width is 8 inches. The pattern shown in Fig. 1 is just 3 inches wide; therefore each pattern on the pattern plate, in Fig. 2, must be 3 inches plus a finish. In between the patterns is a space of 2 inches when finished; this space must be cut out of the pattern plate so that the 2-inch space in the stripping plate can strip the sides of the pattern *A;* the top surface of this 2-inch strip comes flush with the top of the pattern *A*, Fig. 2. See dotted outline of the stripping plate, as it sets in its position on the machine, through the pattern in Fig. 2. The sections of the pattern *A2* and *A3* must be stripped on account of their straight sides; in order to do this, an opening must be cut in the plate around sections *A2* and *A3*; with a drop-pattern machine this is almost always done by cutting the opening clear through the pattern, but in doing so it

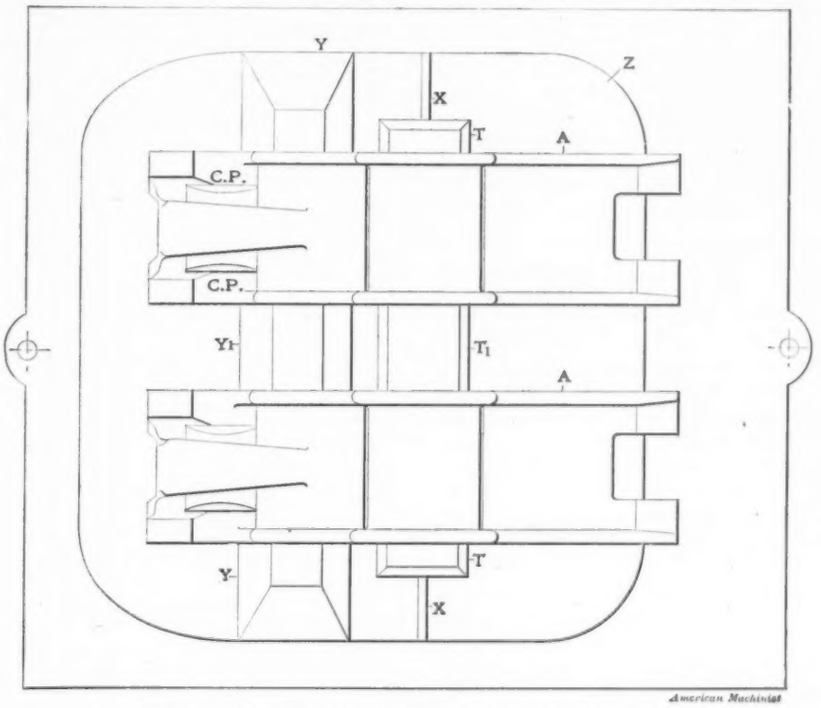


FIG. 4. PLAN OF DRAG, STRIPPING PLATE AND PATTERNS.

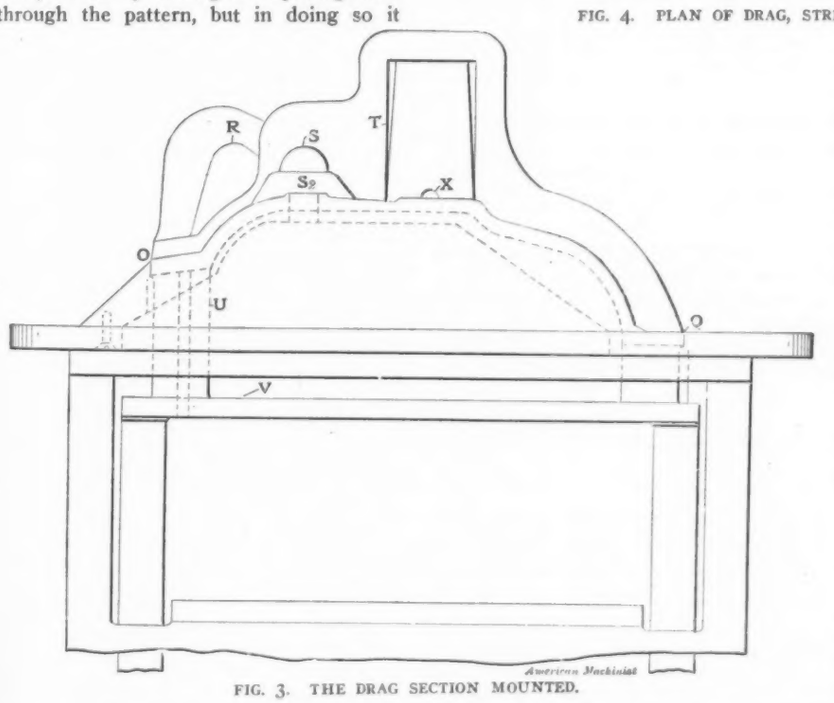


FIG. 3. THE DRAG SECTION MOUNTED.

cuts away all the metal that holds the sections *A2* and *A3* to the pattern *A*, so the pattern sections are then made to bridge the openings under the plate and are fastened to the under side of the plate by means of a screw (*I*) and dowel pin (*J*). This stripping of the two sections could be done another way which I will explain later. The advantage of the first way is that the sand that may get into the opening can fall clear through the pattern to the stool plate, doing no damage and saving time in blowing it out in case it should stay in the opening. The stripper around *A3* is not shown, as it would confuse the view of the stripper *G G;* but it is arranged in a like manner as for A2. These openings are to be finished by file; to save labor in finishing, the thickness of the metal at the filing point should be cut out on the under side of the pattern plate, leaving about ¼-inch thickness of metal. The shape of the pattern at point *A6* in Fig. 1 makes it necessary to use a dry sand core. The core being partly round, as shown, the parting line at its center will come about ½ inch below the parting at the top outline of the pattern. This leaves a nasty little pocket which might make trouble by sticking if not overcome by a stripper; so cut out the stripping plate for the strippers. A plan view of the strippers can be seen in Fig. 5, where they are designated by *E, F* and *G* on the ends and *E1* and *G1* in the center. These openings pass clear through the plate and are to be filed to size; so cut away all unnecessary stock on the under side of the plate to save the filing. The next step will be to make a pattern of the stool plate *M;* this is merely a flat plate made to fit in the machine, finished on top and bottom. The wood pattern for the stool strippers must be made as shown in Fig. 2. *E, F, G, E1* and *G1* are separate patterns, while stripper *H* for the section *A2* is another separate pattern, and *A3* is likewise another. These strippers can be made out of cast brass, a file finish being allowed on the top with a machine finish on the bottom. A small pattern can be made of the section *A1*.

The pattern for the cope stripping plate must now be made. All points on the pattern *A* below the top of the plate *B* must be met by the stripping plate going down to them. The surface of the cope plate that forms the parting line in the deep pocket around the pattern is cut away to the depth of 5-16 of an inch for babbitting purposes. This, then, will complete the wood pattern work for the cope machine, all but the gate, which is of the regular type and mounted on the cope, since this is a malleable casting job.

THE DRAG MOUNTING.

The drag machine is shown with pattern on it in Fig. 3, and the plan of the stripping plate is shown in Fig. 4. The drag machine is equipped with the remainder of the pattern. *O* and *Q* are the extreme ends of the pattern at the parting line, *Q* coming on a line flush with the flask line and also corresponding with point *A*5 on Fig. 1, while point *O* in Fig. 3 corresponds with *A*4 in Fig. 1, *O* being the same distance above the stripping plate as *A*4 was below its plate line.

A master pattern should be made of the drag pattern *A*, and on its under surface add about ⅜ of an inch extra metal and as near straight as possible. Heel-core prints *R* and *T* and core print *S* should be made and fastened to the pattern with screws. Around print S is a small building-up piece to correspond with the shape of the three stools *E*, *F* and *G*, Fig. 2, which surround the core print *L*; this can be formed by babbitting, as the pocket in the other plate will be to correct size. The building-up piece that comes from the main stripping plate up to the point *O* is continued around the pattern on the parting line till it meets at point *Q* on the opposite end. A file finish should be allowed on the sides of this building-up piece, while on the bottom should be allowed a machine finish. In Fig. 4 this building-up piece is represented by *Z*, and it will be noted that it is made for two patterns; four or five small feet can be cast on the sides of the building-up piece so as to hold it while it is being planed on its bottom, and the feet can be cut off when it is finished. The inside of the building-up piece is to be made to the outline of the pattern, allowing 1-16 inch for finish by filling all around the inside, while ⅜ inch down from the parting line, which is *O O* on the inside of the opening, cut the pattern back about ⅛ of an inch; see Fig. 3. The thickness of this building-up piece, in general, is about ½ inch, save on each end, where it has a little extra for support and room for drilling and tapping for a screw; this thickness is shown in dotted lines in Fig. 3, the upper surface of the stripping plate touching the under side of it. The pattern plate is cut away to lighten it and also to allow the pattern support to come from the pattern plate *V* to the pattern, there being one pattern support at each end of each pattern; these supports can be cast on pattern plate *V*. A pattern should be then made of the drag stripping plate, as shown in Fig. 3, as well as the pattern of the plate *V*; this will complete the wood patterns for the drag machine.

Get a good set of castings made and proceed to finish them as follows: Plane off the ends of the four pattern supports *U* and the under side of the plate *V* where it rests on the machine, then plane to the right thickness the building-up piece on the under side; also plane the top and bottom of the stripping plate. Then lay off a center line on the top of each of the stripping plates, dividing it into four parts, and on one line at each end and directly in the center of the two flask-pin ears, drill the holes for the flask pins to fit the molding machine. The two pin-holes must be the same distance from the cross center line on the plate, which line is always to be worked from.

Next proceed to file up the patterns to size leaving off the prints *T* and *S*; next take the building-up piece, lay off a center line on its top surface and from this line locate the edges of the main pattern which will be just 1 inch each side of the line or 2 inches apart, also determine the correct location of the pattern lengthwise and dress out the building-up pieces to these lines, carefully fitting the pattern in the filed openings. When this is done file up the outside of the building-up piece nice and smooth, then proceed to locate the building-up piece on the top of the stripping plate true with the center lines on both parts and fasten together with screws; then fasten the stripping plate to the machine and in the center of each pattern support *U* drill a 5-16-inch hole clear through from top to bottom, also drill the pattern plate *V* to fit the machine. Fasten it on the machine and set the pattern in through the filed opening made for it till the pattern rests on the pattern support *U*, then with a 5-16-inch drill locate the hole in the support *U* on the under side of the pattern, remove the pattern, drill and tap it for a fillist r head screw; in the supports *U* counterbore the center hole out from the under side to take the head of the screw; when the pattern is fastened securely and accurately on the pattern supports, drill down through the pattern into only two of the supports a ½-inch dowel-pin hole in each, make and drive into these holes dowel pins to insure that they never will get out of place. Next take the stripper plate for the cope machine and have it planed to size and drilled for the flask pins. In the interior of the opening that forms the match to the building-up piece, and where the babbitting is to be done, drill and drive in to the section to be babbitted a series of nails till the heads come to within ⅛ inch of the plate. Take the drag pattern and in the place where the building-up piece *S*2 will come drill and drive in some more nails, then directly in the center of this piece *S*2 locate and drill a pouring hole clear through the drag plate.

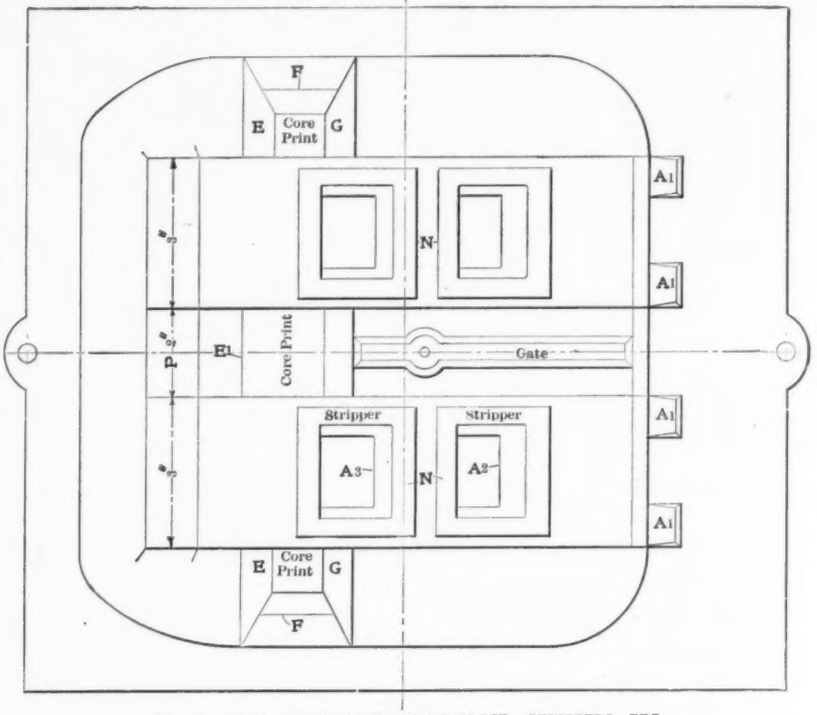


FIG. 5. PLAN OF COPE STRIPPING PLATE, STRIPPERS, ETC.

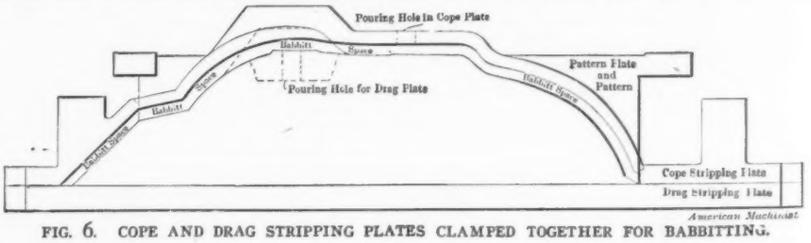


FIG. 6. COPE AND DRAG STRIPPING PLATES CLAMPED TOGETHER FOR BABBITTING.

BABBITTING.

Set the two stripping plates together face to face, with the flask pins holding them true with each other, clamping them firmly together as shown in Fig. 6. The plates can be slightly heated so the babbitt will flow freely in all parts, and with a little putty make a pocket around the pouring holes and pour in the babbitt till full; after the plates have cooled a little and the babbitt has set, unclamp them and finish the babbitt surface where any flaw or imperfection is to be found. The core prints *S* and *T* can now be fastened on the sides of the drag pattern, and the four small pieces *A1* can be fastened on the cope stripping plate. If directions have been carefully followed a perfect match of the pattern will now be had. In Fig. 4 at the end of the core print *T* will be seen a small, half-round vent wire reaching to the outside of the mold to take off the gas in the mold.

AN INFERIOR METHOD.

To mount this pattern as might be done by some one unskilled in the art the cope stripping plate and pattern would be all in one save the points *A2* and *A3*, these would strip down through the stripping plate as they would be fastened to the pattern plate; the pockets around the core print *L*, Fig. 2, would in this case have no strippers to insure against the sand sticking to them; it would always be giving trouble at this point, which is the most objectionable one in this method of mounting the pattern.

In mounting the drag pattern there is no danger of getting it in the wrong way, for it has merely a stripper all around the outline of the pattern.

Machinists Do It for Nothing.

A young man from Baltimore caught a cinder in his eye the other day and went into a drug store to have it out. The druggist couldn't get it out, but a man who was leaning against the counter spoke up and said that he was a physician and could easily remove the cinder. He took the patient across the street to his office and placed him in a chair.

"You know, of course, that I charge $5 for this," he said as he started to take out the cinder.

"Isn't that pretty steep?" gasped the young man from Baltimore.

"Oh, I always charge $5 for removing foreign substances," said the physician, and before he finished speaking the cinder was out. The young man paid his $5.—*The Sun.*

The number of persons on the payrolls of the railroads of this country on June 30, 1904, was 1,296,121, or 611 per 100 miles of line, a decrease for the year of 16,416, or 28 per 100 miles. The wages and salaries paid amounted to $817,598,810 per annum.

Studies in Inventive Problems—X.

Proposed by Leicester Allen and Solved by Various Readers.

I am not receiving so many solutions of Problem III as were received for either Problem I or Problem II. Notwithstanding this, various indications give assurance that the interest in these studies is well sustained. In extreme hot weather and the vacation season most people are seeking recreation and recuperation, and putting aside such matters as can be reserved for future opportunity. Although this article comprises all the acceptable solutions of Problem III that have been offered, I do not wish it to be considered as concluding the treatment of that problem. I shall gladly receive and consider any further solutions which may be offered, not only of Problem III, but of Problems I and II.

I did not judge Problem III to present more difficulty than either of the others, because the use of the shuttle slide, explained in previous articles, is the key to quite a number of slide movements, including such a movement as is required by the terms of Problem III, as well as those explained and illustrated in a general way in the AMERICAN MACHINIST for August 3 of the current year. Accompanying my own solution of Problem III, which I describe hereinafter, I present a modification of the movement by means of which a slide can be made to traverse a rhombic path, which movement becomes entirely practicable by aid of the shuttle slide. I doubt not that slide movements can be adapted to still other paths.

PROBLEM III, SOLUTION NO. 5, FIG. I. CARROLL ASHLEY, ROCHESTER, N. Y.

Although Mr. Ashley contributes this solution, he states that his share in it consists in the preparation of the description, and, as I infer from his letter, the drawing. The solution proper is credited by Mr. Ashley to L. D. Castor, general superintendent of the Eastman Kodak Company, who authorized Mr. Ashley to present it. Mr. Ashley writes:

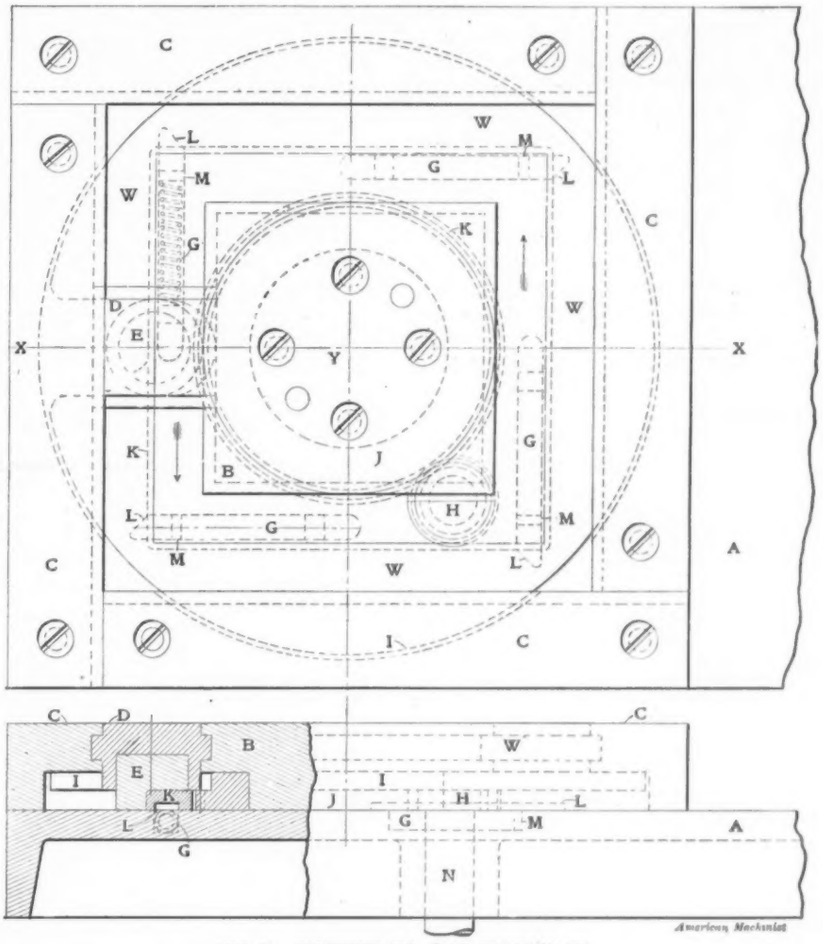


FIG. I. SOLUTION NO. 5 OF PROBLEM III.

"It has been said that 'nearly all mechanical movements are known, and that supposedly *new movements* are but a modified application of the old to secure new or different results.' However that may be, these modified applications are sometimes decidedly interesting and always instructive.

"In some of the solutions of Problem

II it would seem that the answers were 'up in the air.' Take for example Fig. 6, by Mr. Leavitt. There is no provision made to neutralize the tendency of the tilting of the block, which is very essential, as I understand it. In Mr. Castor's solution of Problem III this was the first point taken into consideration; that taken care of, it was then comparatively easy sailing. Mr. Castor has not only solved the problem of the tilting of the block *D*, but has made his mechanical motion self-contained. Referring to Fig. 1, the enclosing pieces or outside guides are lettered *C*. *W* denotes the rectangular ways. The center piece *B* is secured to the table by screws and dowel-pins. The lower part of *B* is turned round to act as a bearing on which the driver *I* and the gear *J* revolve; this is clearly shown at *Y* and in the cross-section at *X X'*. The side pieces *C* are bored out underneath; in this circular opening are the main driver *I* and the secondary driving gear *J;* these two are permanently secured together, and their combined function is to drive the block *D* in the direction of the arrows. A suitable pinion at *H*, keyed to shaft *N* and belted from underneath the table, drives the gear *J*.

"Fastened directly to the table *A* is a square piece *K*. Two circular openings are turned in the center for the gears *J* and *H*. At each of the four corners is milled an opening ⅛ inch deep. This opening retains the tool-steel spring-pawls *L*. These spring-pawls have a lug, shown at *M*, which lugs are continuously pressed outward by springs in the openings *G*, milled in the table *A*. In the center of the block *D* a circular recess is turned in which the round piece *E* is retained. It will be noticed that the lower part of *E* is milled away, leaving a partially rounded lug, that has a bearing against the piece *K*. The only movement that *E* has is a quarter turn to the left as the block *D* passes each corner. It is of course understood that the lower portion of the block *D* that projects into the opening under the pieces *C* and *B*, is turned round and is a sliding fit to the slotted opening of the driver *I*. As the block *D* approaches the corner, the lug on *E* comes in contact with the spring-pawl L, pushing it back into its pocket. It will be noticed that the four corners of the piece *K* are slightly rounded, with a radius equal to the amount that the lug *E* is offset from the center. Now when *D* reaches the corner, the spring-pawl *L* will be free to act on the rear end of the lug on *E* and cause it to revolve one-quarter of a revolution, at the same time holding the block *D* rigidly in the corner, thereby preventing any tilting of the same. Thus it will be seen that the device can be driven as fast as compatible with the safety of the different parts, and at the same time the tendency of the block *D* to tilt has been obviated. The lug on *E* now having been turned one-quarter of a revolution, the block *D* will be free to continue on its course to the next corner, when the same movements will be repeated. The corners of piece *K*, the pawls *L* and the lug of *E* can be made of tool steel and hardened if desired."

I prefer to submit this solution to students of these problems, without, for the present at least, appending any comments of my own. I repeat here the statement

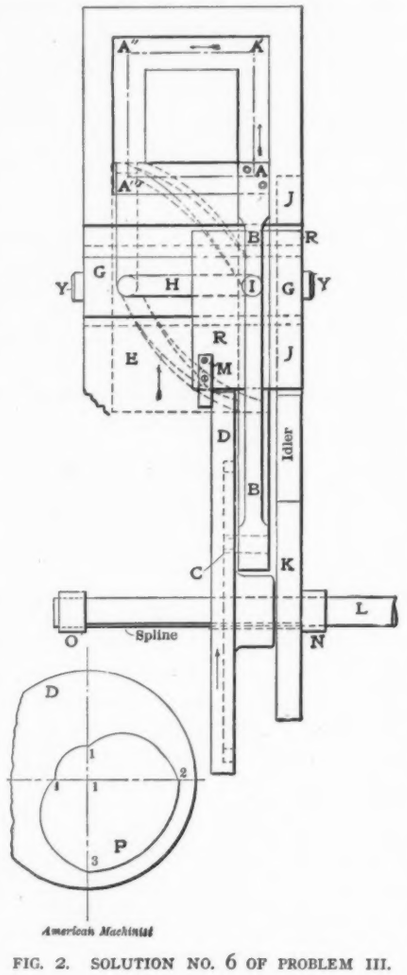


FIG. 2. SOLUTION NO. 6 OF PROBLEM III.

that courteous criticism of any of the solutions—my own included—is invited. I think this series of articles would be likely to be much improved by judicious criticism. I had hoped my own solution of Problem II would have been seen to have a fault which, as it appears to me, is sufficiently obvious to be jumped upon by good mechanics and designers almost at sight. In lieu of criticism by others, I will go at it myself, and, as the foregoing remarks have led up to it, this may be as good a place as any to point out the defect.

I have received a number of personal complimentary letters referring to that solution as solving the problem in "a most satisfactory manner"; as being "perfectly complete"; as "evincing skill in design," etc., etc. Now, I did not so consider it, and I did not expect it would be so considered, at least by some of the accomplished men who thus have attested their commendation.

Having, as has been my custom, submitted my solution to the editor of the AMERICAN MACHINIST before giving out the problem, to show that a solution was possible, I presented it precisely in the same form in the issue of July 6. Scarcely had the enunciation of Problem II been printed before I discovered that my solution might have been improved. But it seems almost incredible that others should not also have perceived this.

Now, while the solution in question completely solves the problem—that is to say, meets all the requirements of the enunciation—it is not *most* satisfactory, it is not *perfectly* complete, and it does not "evince skill in design." I am going to cut out all the superlatives from these commendations. No mechanical design evinces skill that comprises useless, superfluous parts not essential to the successful accomplishment of its exact purpose. My solution of Problem II, as presented, does comprise such superfluous, unnecessary parts. Hence the superlatives which friends have kindly, but too inconsiderately, used in their communications are not merited.

The defect in my solution, which I herewith point out, is that if either the right-hand or the left-hand shuttle block, together with its stop and its locking and unlocking mechanism, be omitted the movement will be just the same, and just as required by the terms of the problem. A locking device for the sliding block at the lower position would, however, be needed. Hence the solution stands fairly open to the charge of involving a superfluous number of parts to accomplish an intended purpose. The locking devices shown in my solution are also needlessly complicated. I expected and hoped that the solution would have been criticized as it merited, but nothing received by me indicates that the defect pointed out has attracted attention.

PROBLEM III, SOLUTION NO. 2. FRANK FAULKNER, INSTRUCTOR IN PRACTICAL MECHANICS, PENNSYLVANIA STATE COLLEGE.

Mr. Faulkner sends a rather incomplete sketch, but, with a little effort, I think it can be understood. The solution, however, is open to the objection that Mr. Faulkner has not observed the restriction that "none of the mechanism, stationary or moving, above or below the table, must at any time extend materially beyond the outer margin of the table *A* projected down to the floor (on which the legs, not shown, of the machine rest), *except the belt or shaft which transmits motion to the machine.*" See page 728, issue of AMERICAN MACHINIST, June 1, 1905.

Mr. Faulkner's description is as follows:

"Referring to the drawing, *A* is the square block or slide, *B* a sliding bar bolted rigidly to *A*, as shown, and working in a slideway formed in slide *R*. The slide *R* fits into the dovetailed slot *G*. *E* is a drum cam revolving on the shaft *Y*. *D* is a disk with a cam groove milled in its face. An elevation would show the position of *D* and *E* much better, but I think their place can be understood. The mechanism is driven through shaft *L*. Gear *K* is keyed to *L* and drives gear *J* through an idler. *J* and *K* have the same number of teeth. Starting with the mechanism in the position shown, the center of the roller *C* being at 1 (shown on the path *P* in detail sketch), we move through an arc of 90 degrees, which brings the center of *C* to 2, while *B* has moved *A* up to *A'*. Through the next 90-degree movement of *D*, *C* is held stationary but cam *E* moves slide *R* through the pin and roller *I*. This pin extends down through slot *H* cut through the top of the table. As slide *R* moves to the left, *A* goes to *A''*, and simultaneously cam *D* is moved to the left, sliding on the splined shaft *L*. The resistance due to friction in moving *D* on *L* is an advantage, as it helps to balance the resistance encountered in moving the block from *A'* to *A''*. Through the next 90 degrees, roller *I* is held stationary, being in a straight path, and *C* moves from 3 to 4, bringing the block to *A'''*. During the next 90 degrees *C* is stationary and cam *E* moves block *A* to the starting point. During this last movement, the finger *M* pushes *D* to the right. The development of cam *E* is so simple that I don't think it necessary to draw it. Of course these cams should be designed to give a uniform motion. It is assumed that the center of shaft *L* is in line with the axis of sliding bar *B*.

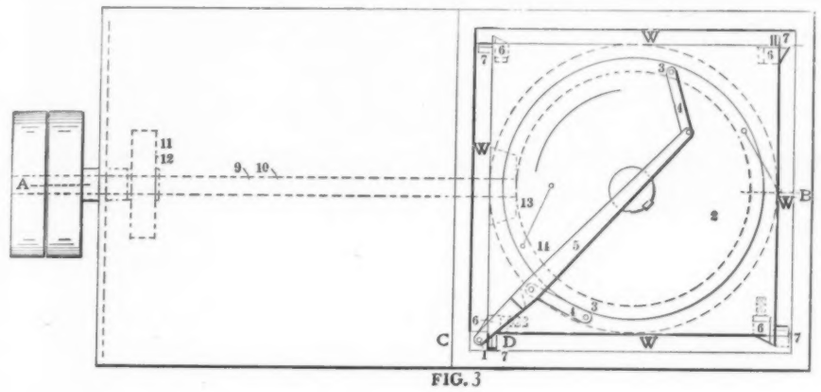


FIG. 3

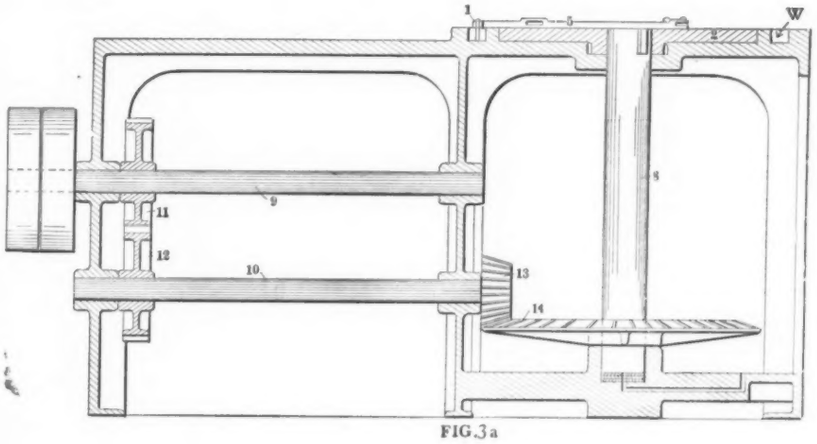


FIG. 3a

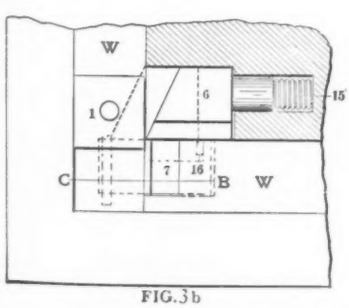


FIG. 3b

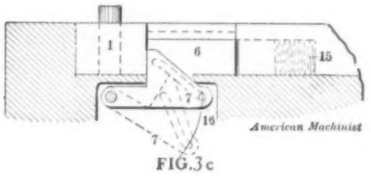


FIG. 3c

SOLUTION NO. 7 OF PROBLEM III.

PROBLEM III, SOLUTION NO. 7, FIGS. 3, 3*a*, 3*b* AND 3*c*. WILLIAM WHALEY, LA FOLLETTE, TENN.

"Fig. 3 is a plan view of device, Fig. 3*a* a vertical section on line *A B* in Fig. 3, Fig. 3*b* an enlarged plan of a shoe and a latch, or tumbler, with table cut away, and Fig. 3*c* is an enlarged section on line *C D* in Fig. 3. The problem is to drive the sliding block through a square path of motion limited by the guideways *W*, with no tilting of the block in turning corners; the mechanism is not to extend materially beyond limits of the table projected to the floor.

"In plan view, Fig. 3, 2 is a circular head keyed to the vertical shaft 8 and fitted in a recess in the top of the table, so that the top edge of the head is flush with the top of the guideways. The pins 3 3 are fixed in head 2 and form pivots for the oscillating links 4 4, which, on their outer ends are pinned in a connecting bar 5, which bar is connected to sliding block 1 by a pin, all substantially as shown in the drawing. The spring shoe 6 and tumbler 7, shown in detail in Figs. 3*b* and 3*c*, are to prevent turning, or tilting, of block 1 at the corners. In Fig. 3*a*, shaft 9, driven by belt on tight and loose pulleys, drives shaft 10 through elliptic gears 11 and 12, which gears are so proportioned that the speed of shaft 10 varies from 1 to 1½. Shaft 10 drives shaft 8 through bevel gears 13, 14, decreasing speed 4 to 1. In operation, shaft 8, with head 2, is driven through the mechanism described, and shaft 8 (also head 2) has four points of highest and four points of lowest rotative speed per revolution, this effect being produced by the elliptic gears and the 4 to 1 bevel gears. The point of highest rotative speed of 2 is when sliding block 1 is midway between the corners, and lowest when 1 is turning the corner, the speed being gradually increased and decreased so as to give block 1 as nearly uniform velocity along the guideways as is possible. The oscillating links 4 4 allow rod 5 to swing backward and forward across circular head 2 to accommodate itself to the position of the sliding block 1. Yet, while swinging back and forth, 5 is compelled to move rotatively with head 2, and hence forces block 1 along its path in guideways *W*. On approaching a corner, block 1 rides up on the inclined face of shoe 6, forcing the same back into its pocket. The shoe 6 has a pin 16 projecting laterally into a slot in the side of tumbler 7, as shown in Fig. 3*c*; so that as shoe 6 moves backward, tumbler 7 is lifted up until, when block 1 has forced shoe 6 completely back, the face of tumbler 7 forms a continuation of the inner guide, and prevents any tilting of the block. As soon as block 1 has passed the edge of shoe 6 flush with the inner side

of the guideway, shoe 6 is forced back to its former position by the spring 15, and tumbler 7 drops out of the way of block 1. The back side of 6 now forms an extension of the inner guideway, so that block 1 cannot tilt backwards. It is to be noticed that tumbler 7 swings *away* from block 1, and hence there is no danger of its being caught by the same and 'hung up.'"

The approximate equalization of motion by the use of elliptic gears is a feature of this solution not presented in any other solution of either Problems I, II or III. The use of the shoe to prevent tilting of the block is, I think, not the best way of accomplishing this end, but I will pass this solution for the present without further comment, except to say that the drawing and description were presented in unusually excellent form.

PROBLEM III, SOLUTION NO. 8, FIG. 4. J. MELANCON, AMITE, LA.

"Arm *E* is keyed to vertical shaft *H*, and driven by bevel-gear mechanism under the table, as shown by dotted lines, and carries block *D* around with it, by means of the pin *E* projecting above the block into the slot in the arm. If proportioned as shown in drawing, no part of the mechanism will project beyond the edge of table. In practice the pin *F* would be held in a sliding block in the slot of arm *E*. The mechanism for preventing canting of the block while passing the angle of the path is shown drawn to a somewhat larger scale. Block *D* advancing in direction of the arrow, first comes into contact with button *a* which is held in its normal position of projection into the slide-way by a flat spring *k* which may be supplemented by a coiled spring *b* if found necessary. The button *a* is pushed back, bringing catch *c* (which oscillates upon pivot *d*) down upon the end of stop *e*, holding it in position across the path of the block as long as the button is depressed by the block. But as soon as the back edge of the advancing block passes the button—that is, at the instant that the block arrives at its extreme corner position, the coiled spring *b* forces the button *a* back into its first position, thus releasing stop *e*, which, being pivoted at *f*, is pushed out of the way by the advancing block. An arm *g* with a toothed segment on its end is keyed to shaft *H* in such a position as to engage with the pinion *h* (which is cast in one piece with stop *e*) at any time after the block has passed the point *j*. The number of teeth in the segment bears such a ratio to the number of teeth in the pinion as to give it a movement of slightly more than a quarter turn, say 100 degrees, thus leaving it in position to engage with the catch *c* when the button *a* is depressed by the block. Of course, it will be necessary to have a like mechanism at each corner of path. The segmental arm and pinion may be placed either above or below the table."

This solution was referred to in the previous number of this series, and it is the second one sent in by Mr. Melancon. It solves the problem, but I have doubts that the mechanism for holding the block from tilting while turning corners of the path could, in practice, be worked out to a satisfactory practical conclusion.

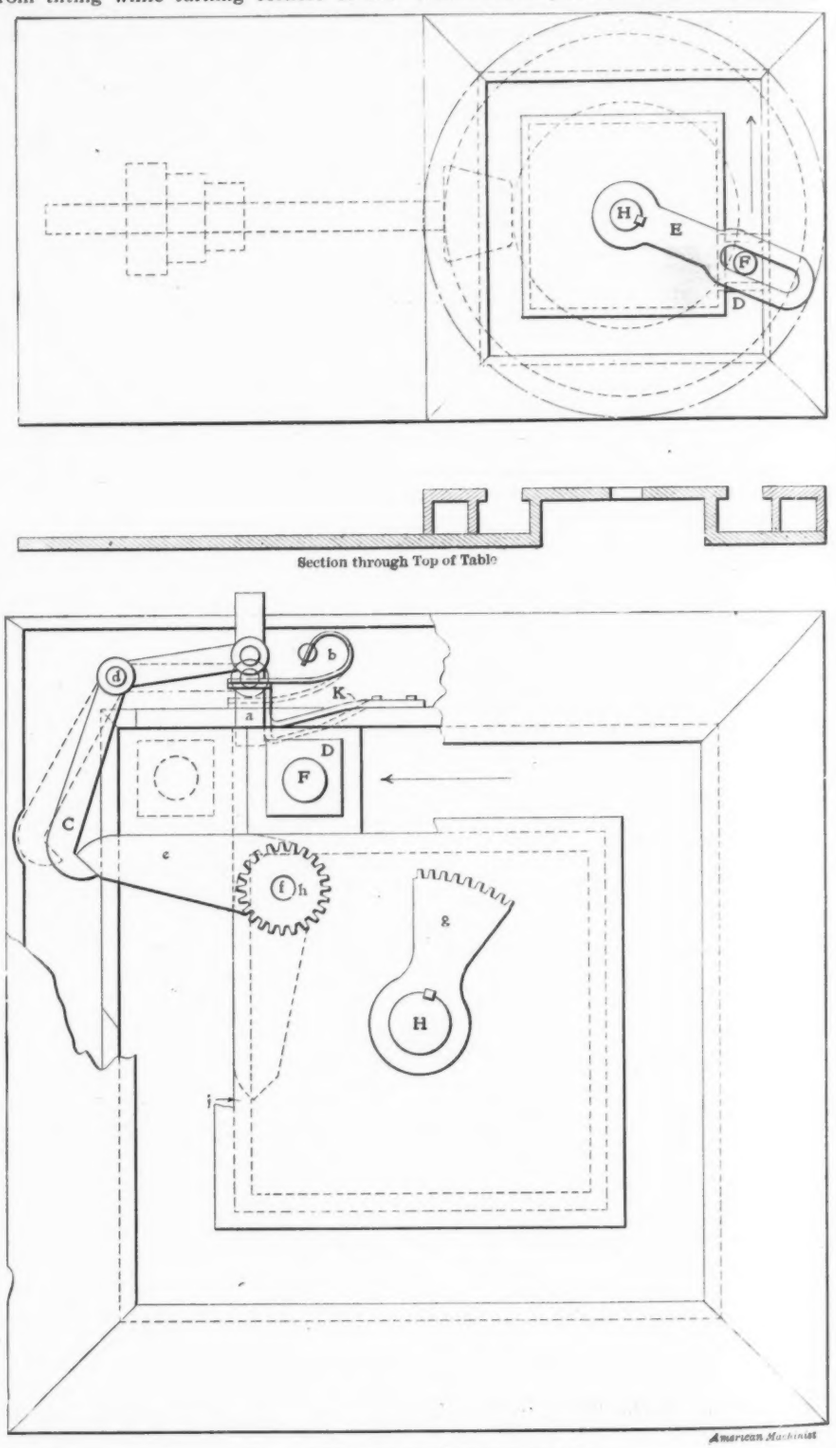


FIG. 4. SOLUTION NO. 8 OF PROBLEM III.

PROBLEM III, SOLUTION NO. 9, FIGS. 5 AND 5a. WERNER WHEATLEY, SPOKANE, WASH.

Mr. Wheatley's solution might, perhaps, have been made more readily comprehensible by a more elaborate description. It introduces the element of forked slides to hold the block from tilting, which are good devices for the purpose, but in their operation they involve more mechanism than is required for operating the shuttle slide. I think, however, the forked blocks might be connected in a manner substantially analogous to that shown in my solution below, and thus avoid some of the mechanism required in Mr. Wheatley's solution, whose description follows:

"*W W W W* is the square runway in which the block *D* must move. *S S* is a

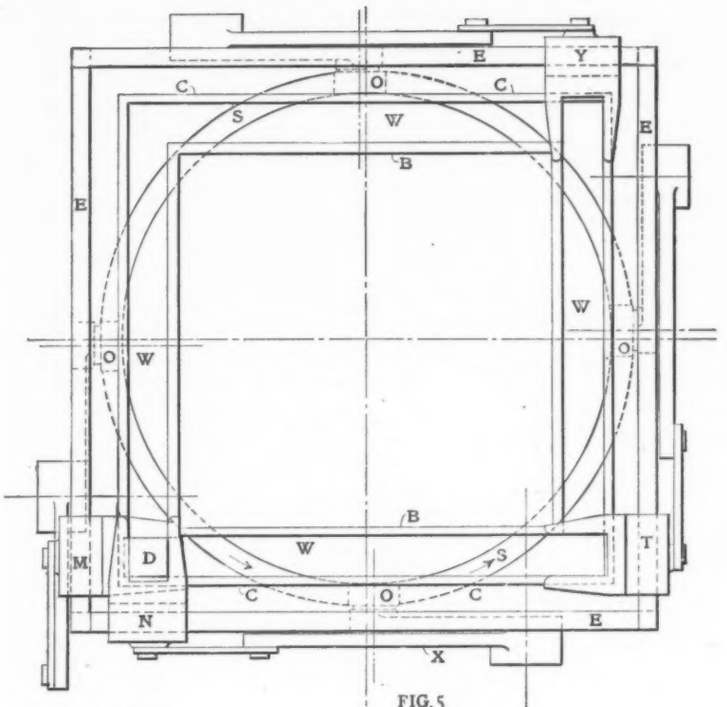


FIG. 5

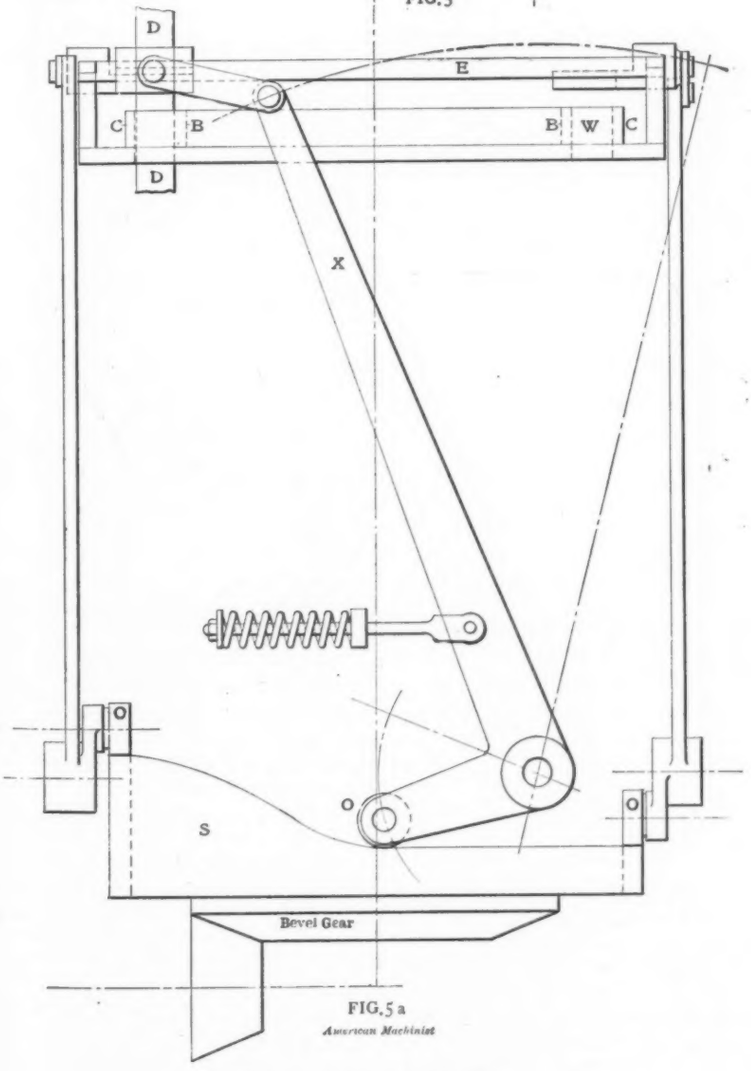


FIG. 5a
American Machinist

SOLUTION NO. 9 OF PROBLEM III.

cam, driven by gearing, shown in Fig. 5a. *X* is one of four bell cranks, driven by the cam *S S*, and serves to move the block *D* from corner to corner by the forked blocks *M, N, T, Y*, these blocks being connected to bell cranks, as shown. *E E E E* is a square guide on which the forked blocks move. The forked blocks are returned to their starting point by a spring or a suitably made cam. The arrow, Fig. 1, indicates the direction of rotation."

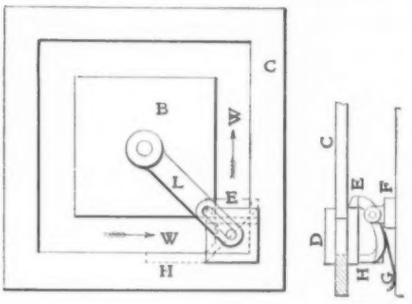
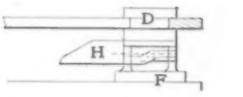


FIG. 6



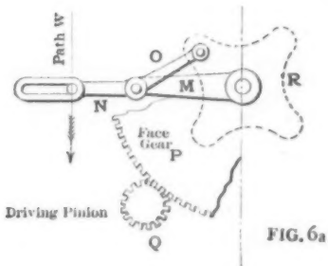


FIG. 6a

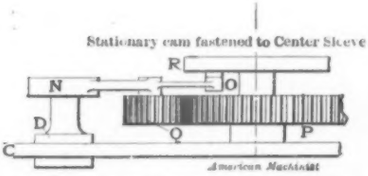


FIG. 6a. SOLUTION NO. 10 OF PROBLEM III.

PROBLEM III, SOLUTION NO. 10, FIGS. 6 AND 6a. CARL J. ULMANN, NEW YORK CITY.

"Referring to the figures, lever *L*, Fig. 6, moving at uniform speed around an axis located in the center of piece *B*, and having at the other end a slot, propels the block *D* by a sliding pin or collar projecting from said block. The block is provided on all four sides with upper and under lips to hold it firmly while traveling along the path. To provide against tilting, there is at each corner an extra guide *E*, which is held and can swing on stand *F*, and is ordinarily depressed through the action of spring *G*. On the opposite side of stand *F*, and rigidly connected with *E*, there is the nose piece *H*. When the block approaches the corner, it will depress nose *H*, and consequently elevate the extra guide *E*, which, acting against block *D*, prevents tilting. At the moment when block *D* arrives at the corner it also clears the end of nose *H*; consequently spring *G* will lower piece *E* and clear the path for

the further advance of *D*. In this arrangement the speed of the block varies constantly. If uniform speed is required, replace lever *L* by a shorter lever *M*, Fig. 6a, which would move block *D* by means of a bell crank *N O*. At the end of *O* there is a roller running in a stationary cam *R* shaped to make the motion of the block a uniform one. The cam in my free-hand sketch shows about the requisite shape. Lever *L* or *M* can, of course, be replaced by a gear *P*, which would carry, attached to its side, the bell crank."

Mr. Ulmann's solution covers all the requirements of the problem, and in addition supplies an ingenious method of equalizing the motion of the sliding block. This sustains my statement, made on page 163, that the equalization of the motion of the block can be easily accomplished by the employment of a cam, when such uniformity is an essential requisite. My reasons for not including uniformity of motion as an essential condition in the enunciation of the problem were stated in Article IX of this series.

Having thus presented all the available solutions of Problem III which have come to hand, except my own, I will here say that further solutions of any of the problems, if supplied, will be received and considered; so it is not too late for anyone to furnish a solution which he may have worked out since the beginning of this series, and held back for fear of being too late in offering it.

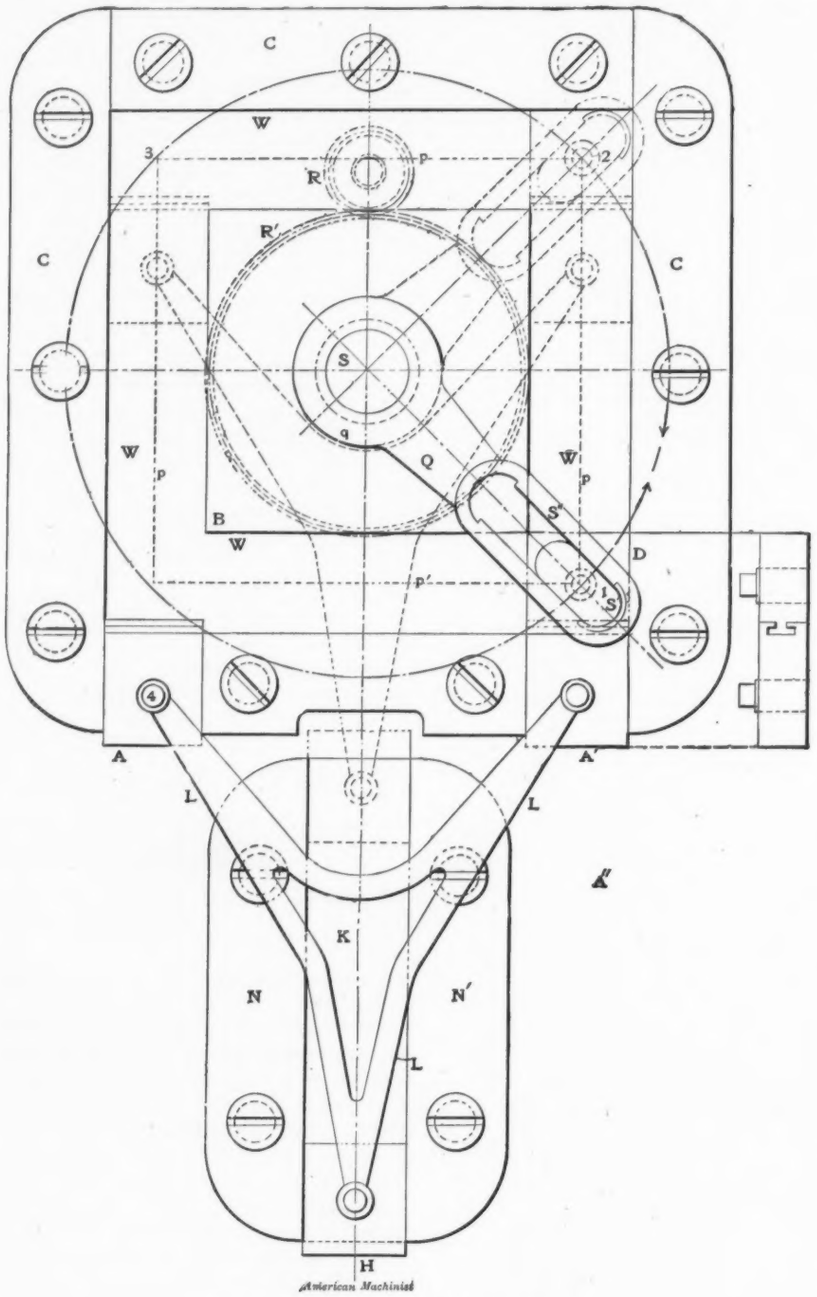


FIG. 7. SOLUTION NO. II OF PROBLEM III.

PROBLEM III, SOLUTION NO. II, FIG. 7.
LEICESTER ALLEN, NEW YORK.

It will be seen that I make use of two shuttle slides, *A A'*. These shuttle slides are connected by a furcated bar or link *L* with an ordinary sliding block *H*, which reciprocates in a way *K* included between two parallel guides *N N*. These are bolted to that part of the table *A"* left vacant in the diagram used in the enunciation of the problem. *D* is the block whose center is required to describe a rectangular path, always in the same direction while passing over any one of the four branches of such path. This rectangular path is indicated by a dotted outline drawn on the way *W*, midwise between the outer margins of the square piece *B* and inner margins of the exterior guides *C*. All the guides *C* and *N* are bolted to the table. The guide *C'* is of a length which permits *A* and *A'* to take the position shown whenever the block *D* is in the position shown, and at all times while the center of *D* is describing the branch *p'* of the rectangular path *p' p p p*, which this center is required to describe. To a stud bearing *s* is fitted a slide *s'*, the stud bearing *s* being fast to the block *D* and joined thereto in such position that its vertical axis, extended, passes through the geometrical center of this block. The slide *s'* works in the slot *s"* of a slotted rotating arm *Q*, the inner end *q* of which is keyed to the vertical shaft *S*, the vertical axis of which passes through the geometrical center of *B*, wherein is formed a bearing for shaft

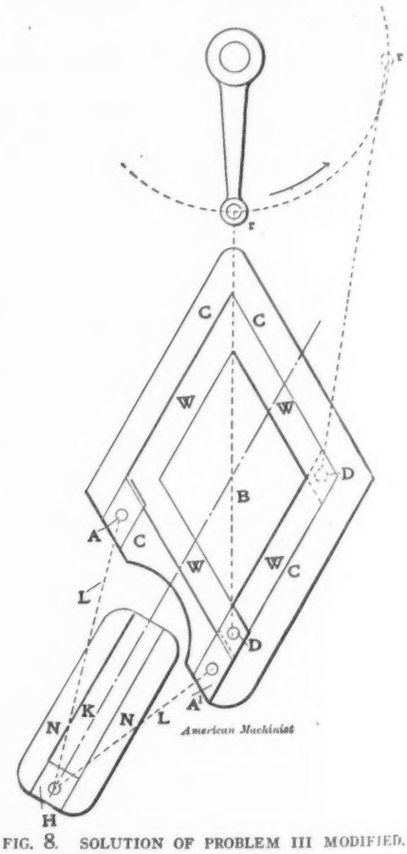


FIG. 8. SOLUTION OF PROBLEM III MODIFIED.

S. Shaft *S* may turn continuously clockwise or in the reverse direction. Suppose the shaft *S* to be driven by a horizontal pinion—shown in dotted outline at *R*—meshing with a horizontal spur gear *R'* keyed to shaft *S*. The block *D* (which is tongued into a tee-slot in *A'* to a neat working fit in the manner described for this device in my solutions of Problems I and II) will be moved from position 1 to position 2, carrying with it the shuttle slide *A'* to the position of the latter indicated in dotted outline. The shuttle slide *A'* also moves the furcated link *L*, the slide *H* and the other shuttle slide *A* into

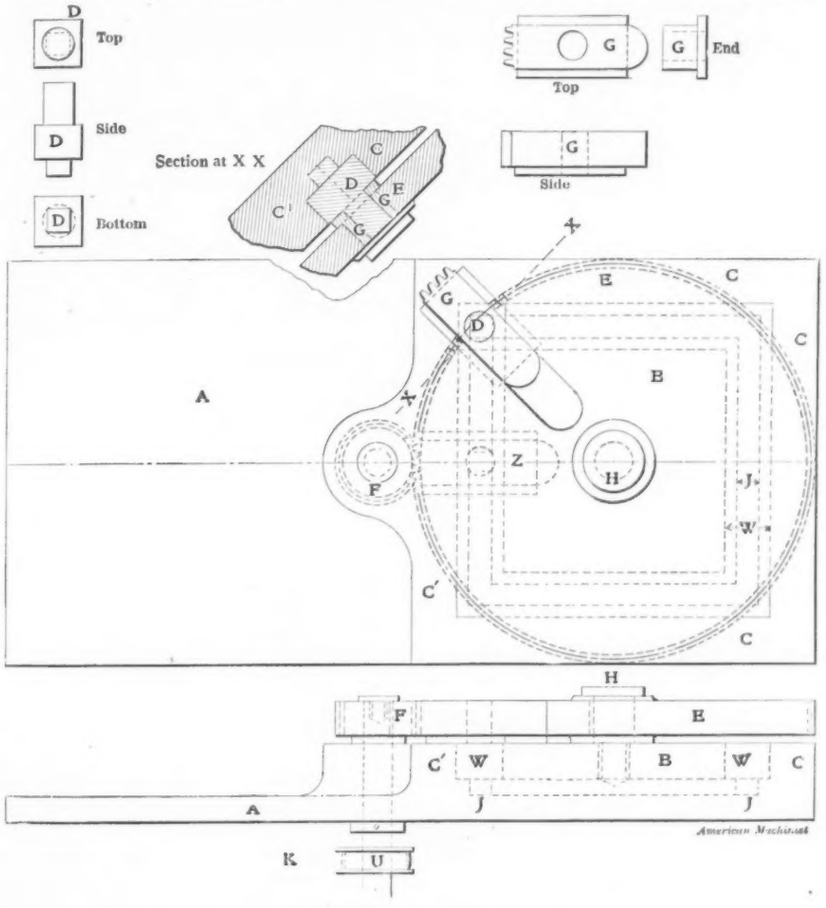


FIG. 9. SOLUTION NO. 12 OF PROBLEM III.

positions shown in dotted outline. Without any pause in its movement, the block *D* then begins to move to the left over the succeeding branch of the path, and, disengaging from the shuttle slide *A'*, passes to position 3, there getting into full engagement with shuttle slide *A*. Next moving over the path to position 4, it pushes *A* back to its first position, moving also *L*, *H* and *A'* back to their original positions. Traversing next the branch *p'* of the path, it disengages from *A*, and moving to position 1, re-engages with *A'*. These motions are repeated in the same order for every revolution of the slotted crank arm *Q*.

It will be obvious that the path need not be a rectangle of equal sides or a square; it might be a parallelogram, in which two opposite sides are equal and each twice the length of either of the other two sides; but in such case, a drive cannot be advantageously obtained from a vertical shaft whose axis passes through the geometrical center of the path. The drive can be supplied by cam or crank, however, a cam being preferable, if uniform motion be required for the block *D*. The block *D* can also be moved in a rhombic or rhomboid path. The diagram, Fig. 8, will make this clear. Only two shuttle slides will be needed; but a modification of the furcated link will be called for. In this diagram the dotted lines *r D* show positions of pitman or link when *D* is in position indicated by full outline, and also when the crank-pin *r* has moved through a quarter of a turn in the direction indicated by the dart. The other letters of reference indicate the same parts that they indicate in Fig. 7. Stops and locks for the shuttle slide might be necessary, as exemplified in my solution of Problem II, page 14, issue of July 6, 1905.

Since the foregoing part of this article was prepared, I have received the following solution:

PROBLEM III, SOLUTION NO. 12, FIG. 9. F. W. BACH, ILION, N. Y.

I do not think the provision against tilting of the block *D* is adequate in this solution, but the drive is so unique and original that I am sure it will interest others as well as myself. It will be seen that the provision against tilting is a square boss on the under side of the block *D*, which runs in an extra guideway, narrower than the main guideway for the block *D*. It appears to me that this boss, if working play is allowed, will tilt when it gets near the angle of the path, just as readily as the main block would without any provision for preventing tilting. Also there will be slight inaccuracy in the working of the teeth on the end of slide *G*, to which I direct the reader's attention.

Mr. Bach lettered the main parts, as I did in the enumciation of the problem, *A* being the table, *B* the square center-piece. He describes the device as follows:

"*C C C* are guides, *C'* the fourth guide, being provided with a boss to hold the pinion *F*. The belt *K* drives the pinion *F* by pulley *U* and shaft *I*, which in turn drives the gear *E*, which is a running fit on the shoulder screw with head marked *H*. The gear *E* has a radial slot cut in it, extending to the circumference and taking out four teeth. This slot has a nicely fitting slide *G* with four teeth on the outside end, and is fitted and adjusted so that when in position *Z*, as shown in dotted outline, it will make a complete gear. The radius of the arc of the pitch line of the teeth on the slide will be some less than for the teeth on the gear, to be correct. The block *D* is driven by the slide *G* by means of the strong round stem on the top part of the block. The provision against the tilting of block *D* is extra guideway or groove *J*, which is about one-half as wide as the main guideway *W*. The square boss on the under side of the block *D* slides in *J* while the main body slides in *W*."

Mr. Carl J. Ulmann, whose solution Nos. 11, 12 and 13 of Problem II were published in Article VII of this series, issue of June 1, has very kindly called my attention to another solution which is like his solution No. 11, except in the drive. When this solution came to hand, together with the one above named, I considered it essentially the same as his solution No. 11. But he has pointed out to me that the change in the method of driving the sliding block impels the latter, when at the angle of the V-path, exactly in the direction of the particular branch (either the right or the left) which the block then has to traverse. He thinks this to be a good feature; but, if the shuttle blocks guide the main sliding block at the angle of the path, it appears to me that this is not essential. I present the solution below, which may be compared with solution No. 11.

PROBLEM II, SOLUTION NO. 32, FIG. 10. CARL J. ULMANN, NEW YORK CITY.

The description is quoted from Mr. Ulmann's letter:

"To my three solutions of Mr. Leicester Allen's problem No. 2, I herewith beg to add a fourth one, which I think is clearly explained by the sketch enclosed, and

which I believe should be as simple and mechanical an arrangement as can be devised for the purpose. The rocker arm *A* is oscillated by connecting rod *B* from the driving shaft and crank between positions *a*-1 and *a*-3. It is evident that in the original position *a*-1 shown, the guide block is bound to enter into the left branch of the guide *V*, and from position *a*-3 it is bound to enter into the right branch. The corresponding positions of the pin as shown on the sketch being *a*-1 and *a*-3 when the block is at the apex of the *V*; *a*-2 when the block is at *a*-2 in the left arm, and *a*-4 when the block is at *a*-4 in the right arm of the guide *V*. Parts *E* and *F* are the auxiliary guide blocks, as described in my solution No. 11, it being understood that block *D* is dovetailed into

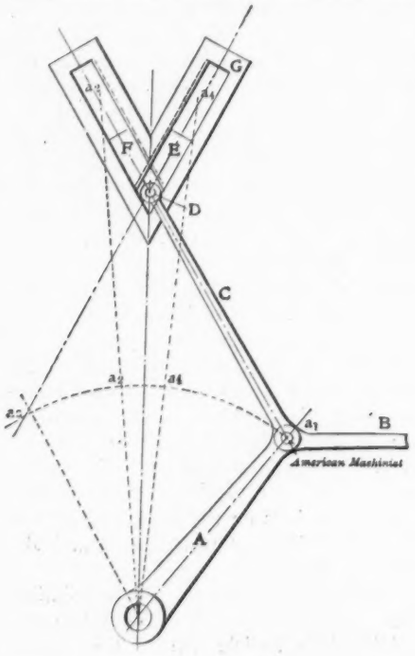


FIG. 10. SOLUTION NO. 32 OF PROBLEM 11.

both these as well as into the inner surface of the guide *V*. Referring to my sketch, it occurs to me that a somewhat better and more mechanical action might be obtained by shortening somewhat lever *A*, and by lengthening connecting rod *C*. The distinctive feature of this sketch is that at the outset of the movement the connecting rod *C* always points straight in the direction of whichever branch of the guide *V* the block is intended to enter into."

German manufacturers are reported to have made a marked advance in their manufacture of pneumatic tools and compressors. These tools have been introduced in the great Krupp works with success and a well-known firm in Frankfort insists its tools are now superior to the American, and considerably less expensive. A branch factory will probably be established in the United States, and the improved German tools put in competition with the American.—*Popular Mechanics.*

Letters to the Editor.

A Stud Chuck for the Bolt Cutter.

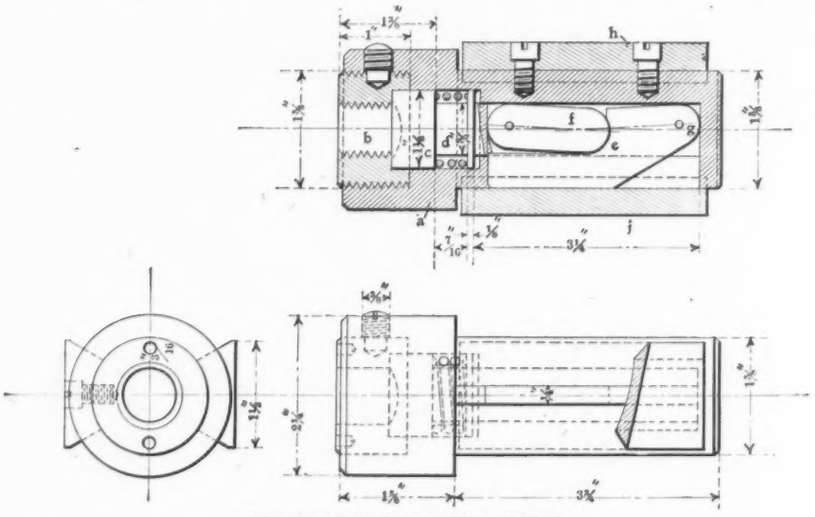
The accompanying sketch represents a stud-holder that we made for use in a bolt cutter for holding one threaded end of a stud while the operation of threading the other end is being performed. The gripping jaws, for holding bolts on this machine, moved in and out across the carriage and the hardened steel jaws were let into dovetail grooves; this tool was made to fit in these in place of the jaws, as will be described later.

The tool consists of a round steel body *a*, which is bored and threaded to receive collet *b*, which is made an easy fit in the thread. The collets are made of the various sizes within the capacity of the tool; in our case the sizes range from ¼ to 1 inch. The length of the thread in all of these collets equals one diameter of the particular size used; for example, the collet for ¾-inch stud would have a length of thread equal to ¾ inch. A case-hardened pad *c* accompanies each collet and is shaped to receive the end of the stud, which we round off ⅛ inch on all sizes. The total length of *b* and *c* is made the same in the entire set for this holder, which is in our case 1⅜ inches, so that with the 1-inch collet, *b* is 1 inch long and *c* ⅜ inch long; while in the case of the ¼-inch collet, having a thread ¼ inch long, the length of *c* = 1⅛ inches This standard length for all sizes is necessary, as will appear later.

Part *d* is designed to be forced up against *c* by action of the toggle *e f*, and is made of machinery steel, has a collar left on as shown, and is split with a ¼-inch milling cutter for a considerable distance from its rear end to receive the toggle. The side of *a* is also opened for the toggle, which is made of two pieces of flat tool steel, the length between points *g g* being so arranged that when the outside edge of *e* is flush with the outside of *a* the center lines *g g* of the toggle levers will be slightly at an angle with each other, as shown. A coil spring, made of steel wire, is slipped over the end of *d*, and presses *c* and *d* in opposite directions, keeping *e* snug against the inner face of *b* and *d* backward against the end of *f*, throwing lever *e* outward. The jaws *h* and *j*, which are fitted to the clamping head of the carriage, are bored axially true with the spindle and die head of the machine. Jaw *h* is secured to the side of *a*, diametrically opposite the toggle lever *e*. Jaw *j* is not fastened and allows *a* to move to and from it. A screw is provided, as shown, to prevent the threaded collets from turning out when in use, all of the collets being spotted to receive the end of this screw.

In use, the bolt jaws are removed and the jaws *h* and *j* slid into place in the bolt cutter and closed on the holder, which action throws *e* inward, and by the action of the toggle *d* is moved outward against *c*. A stud blank, having one end threaded, is then screwed into collet *b* and the threading operation performed on the other. This operation, as usual, screws in the stud with considerable force against *c*, and after this operation is completed the jaws *h* and *j* are opened, which allows *e* to move outward, relieving *c* of the pressure of the toggle and allowing the stud to be unscrewed with the fingers, making the use of any wrench unnecessary; so that when the proper size collet is in place, the operations are as follows: Close jaws and screw in end of stud; thread stud; open jaws and remove stud. These directions are stamped on the tool for the guidance of the operators, new and old alike. Collets *b* are tapped an easy fit for the studs, and plug *c* is made with a little less concave than the end of the stud to prevent crushing the thread and thereby causing the stud to remove hard.

The parts subjected to wear are hardened and tempered. This makes a neat and durable tool, and is very much quicker than anything that we had used up to the time of its advent. E. A. R.



STUD CHUCK FOR THE BOLT CUTTER.

Bending and Forming Dies.

The drawing shows a small tool I designed for forming connector clips in the power press. After blanking to the shape in Fig. 1 these clips are formed at two operations like Figs. 2 and 3, and with one stroke of the press, the two former being arranged side by side on the same bolster as shown in Fig. 4. The one shown on the left is the tool for the first operation, the one on the right completing the clip.

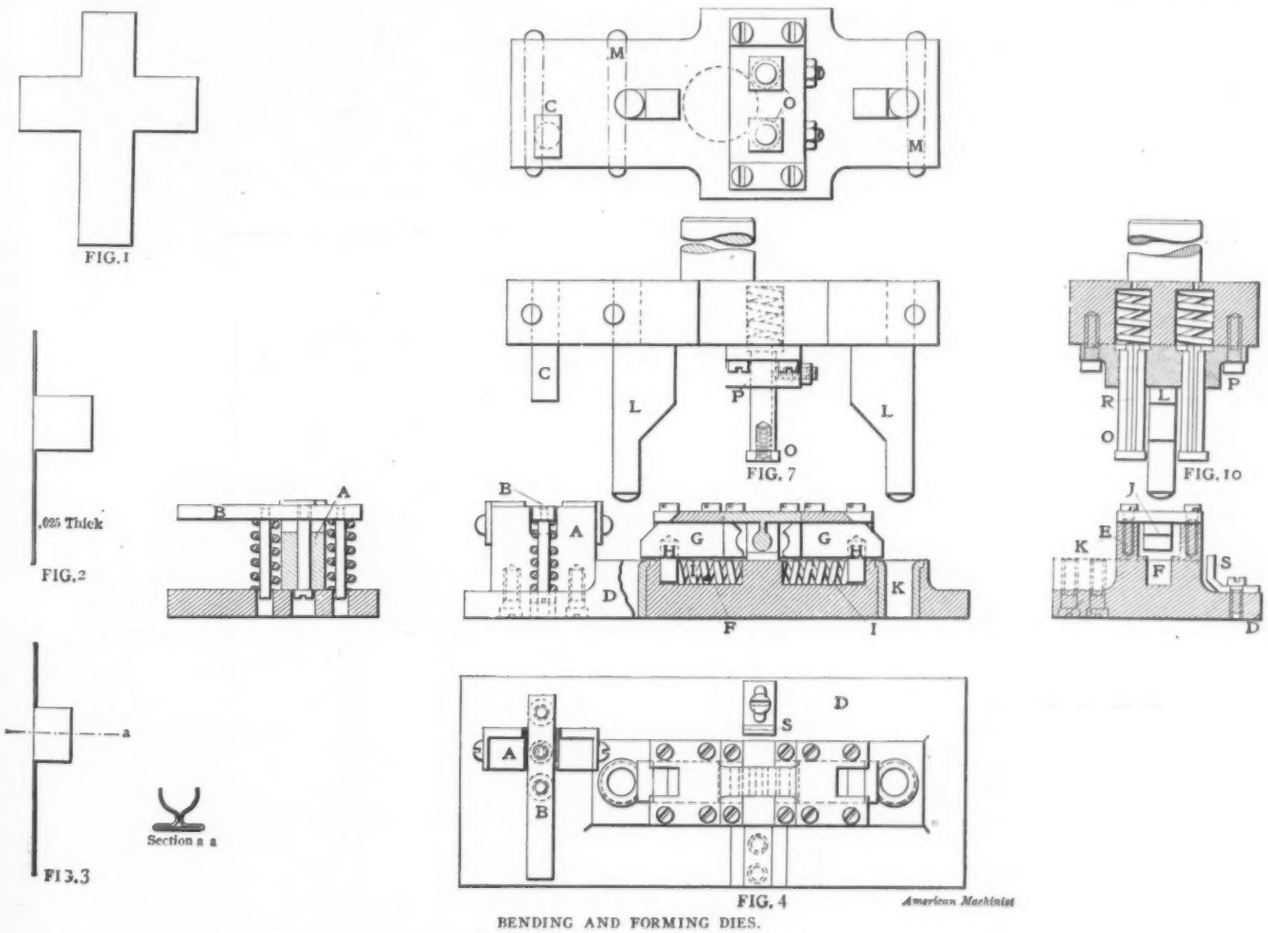
A is the former block for the first operation and is fastened to the bolster with two screws. On the sides of the block are also two stops for locating the blank. In the center of the block is a slot the width of the blank in which the stripper *B* operates. This stripper rests upon two springs, the latter being kept in position by two guide pins riveted in the stripper and which slide in two holes drilled through the bolster. The stripper is kept to the proper height by the fillister head screw as shown. *C* is the former, the shank of which is fastened in the holder by a taper pin.

In the tool for the second operation, *D*, the bottom bolster and *E E*, the guides for the forming slides, are a single forging. Between these guides are two recesses *F*, in which the slide springs operate. *G G* are the forming slides, driven into the bottom of which are two pins, *H*, against which the springs *I* bear. The slide caps are fastened to the guides with screws, the center cap carrying underneath a lug *J*, around which the clip is formed. *K* is a block in which the clip rests while being formed. *L L* are the drivers which are fitted tight in the holder and fastened by the taper pin *M*. Their lower ends slide in the bushes *N*, and the ends of slides *G*, on which they work, are hardened. On either side of the lug *J* are the plungers *O* which keep the body of the work down while the arms are being bent up. The plunger heads are backed by springs, and upon coming down upon the work remain stationary while the forming is taking place. In the bracket *P* are two screws, the points of which fit the V-grooves *R*, machined the whole length of the plunger. These screws prevent the plungers from turning in their sockets, and after being set are locked with their nuts.

The second operation is as follows: After setting, the ram ascends and the springs *I* force the forming slides open; the semi-formed clip, Fig. 2, is now inserted, being pushed up to the stop *S*, and the ram descends, bringing with it the plungers *O* which hold the piece firmly while the drivers *L* force the forming slides *G* forward. The ram again ascends and the slides resume their former position, leaving the tool again open to receive the work.

E. T. KLAPS.

Sheffield, England.



BENDING AND FORMING DIES.

First Aid for Dirty Hands.

For a *first* cleaning compound for the hands, mix a 5-cent package of either Pearline or Soapine with 2 pounds of cornmeal; mix dry and use after wetting the hands. It will not chap the hands in cold weather, and is much better for cleaning than soap.

F. L. NICHOLS.

For the Final Hand Wash.

It makes me smile when I read some accounts of how to keep your hands clean when at work. It is best to work while you are supposed to without thinking of soiling your hands. Now, I'll advise those who will try a good thing to first wash their hands with some soap to take off the top grease and then use Amondamina (prepared by the Dr. Jacob Knob Amondamina Company of 730 Oxford street, Philadelphia). I have been using it for the past five years, and I would not be without it at any price (and it is very cheap). It leaves the hands soft and pliable after using it and takes the dirt out of the pores of the skin. I am not interested in the goods in any way, but I speak of it because of its qualities and for the benefit of machinists in general.

M. E. W.

"Hurry-Up" Tools—A Circle Punch.

I had a young fellow watching me laying out some sheet-iron work not long ago, and as I had a great many holes to drill I used the punch shown in the sketch instead of scribing the circles with the dividers and marking them with a prick-punch, and he spoke up and said: "You have got some of those hurry-up tools," which sounded very funny to me, and I had a good laugh about it. Then he told me that in the last place he worked one man was always beating the rest of the workmen in laying out and they could not find out how he did it. They could see by his work that he did not use dividers for laying out his circles to guide the drill by, and one day he forgot himself and left his circle punch on the bench, and now they have them in the toolroom for all the boys to use. I have used this punch for some time, and for work where it can be used it is a big help. You can make the center for your drill mark with a center punch; place the point of this tool in the center and strike with hammer and you have a circle as heavy as you may choose to make it.

A HANDY CIRCLE PUNCH.

When making the punch I used tool steel, hardened it all over and drew to a dark straw color, and it has stood hard work very well. The plunger must be a close fit and work smoothly. The plunger spring is No. 20 Brown & Sharpe music wire, made just strong enough to keep the plunger out, and the top coil is opened up so as to fit in the punch tight so as to hold the plunger from dropping out.

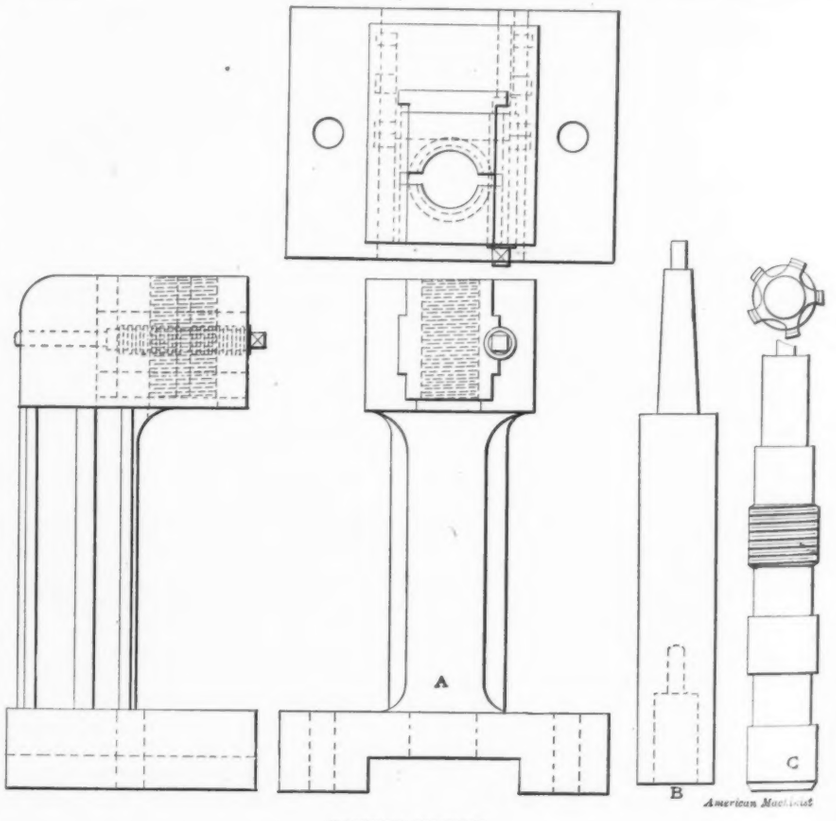
H. S. GILLETT.

A Tapping Fixture.

I am sending you sketches of a fixture to be used on a drilling machine for tapping holes in brass bars such as are used on switchboards, the bars being about 1½ inches thick, the holes tapped 1½ inches diameter, ten threads per inch. *A* is a gray iron bracket with a gap at the bottom for locating the bars and holding them while they are being tapped. There are two holes for bolting to the table; the top is cast with a groove so that the machining can be easily done for the two half nuts. The halves are fitted in and opened and closed with a right and left hand screw similar to a drill chuck.

The adapter *B* for the special tap *C* is turned taper to fit the drill spindle in the usual way; the other end is cored parallel to fit the end of the tap. The outside of the adapter is threaded the same as the hole to be tapped, viz., ten threads per inch, also to fit the split nuts.

The tap is specially made for the job. It will be noticed that it is divided in steps and each is 1 inch in length. This is done to reduce the friction in tapping. It is made with five flutes. The backing off or clearance is a special feature in this case. The first two steps are tapered in the length. In the first step there being ten threads and the flutes being five in number, there are fifty cutting edges in each step. In this case each spiral or complete turn is reduced .003 inch smaller in diameter beginning at the top of the second step, thus leaving .003 for every spiral to cut, and by the time the tap has gone past the second step it has left a full thread. Now there being five cutting edges to each turn of the tap, each of these being .0006 inch under the next edge, only .0004 inch is left for each cutting edge to do.



TAPPING FIXTURE.

The way the fixture is used is to bolt it on the table central with the spindle. The adapter is fixed securely in the spindle, the top put in the holder and the bar put in the recess in the bottom of the fixture. The nuts being open the spindle is brought down so the end of the tap just comes down to the work. The nut is then closed and the machine started, the adapter gives the correct pitch and there is no danger of the thread being stripped or losing its pitch, and as each cutting edge is doing its share of work it goes through easily and makes a neat thread. The last step on the tap is left parallel to size the hole.

The split nut is of gun metal, the tap holder or adapter of cast steel highly polished. When the hole is tapped through the tap drops through the hole in the drill table.

CHAS. PETITJEAN.

London, England.

Moriarity Sees a Pond Planer for the First Time.

I was walking through the machinery department of the Philadelphia Bourse some time ago with my old friend Moriarity. Over in one corner, on exhibit, was a spiral geared planer. The man in charge had placed a glass on the table of the planer. The glass was full to the brim with water, the idea being to demonstrate the absence of shock at the time of reversal. I had seen the trick many times before, but it was new to Moriarity.

"Dixie thot's wan o' thim pond planers ye read so much about in th' AMERICAN MACHINIS' paaper! D'ye see the foine fillamaloo wurrk on th' cross trees av ut? Taake note o' th' little *pond* th' attindint is a planin' av." "It's a Gray planer," said the attendant. "You're a loiar, uts blaack. Young maan, d'ye think oim color blind?"

DIXIE.

Springs With Initial Tension.

The article on initial tension springs, at page 728, Vol. 28, Part I, led me to think that an account of how I made some springs of that kind might be interesting I had considerable trouble getting sufficient tension on the large-size springs, until I made the device shown in Fig. 1. A piece of ½x1-inch tool steel was bent to shape, a hole for the wire to run through was put in at *a*, and that end was hardened. Two pieces of hard fiber were laid along the side of the tool, between which the wire was gripped by means of the bolts and straps. This gave all the tension needed. The set was obtained by having the wire approach the mandrel at sufficient angle to crowd the coils together hard. A parallel clamp provided with hard fiber jaws was clamped tightly on the spring in the position shown. That prevented the wire from riding upon the coil already wound. The lathe carriage was geared up to the correct pitch.

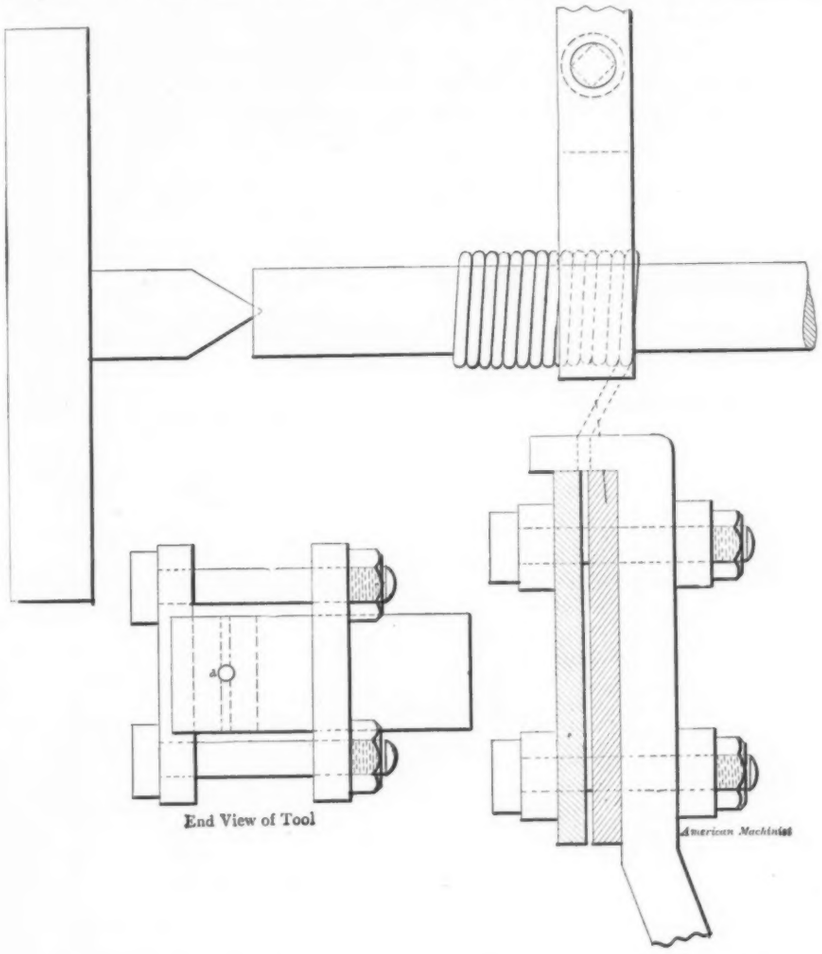


FIG. 1. TOP VIEW OF DEVICE FOR WINDING HEAVY INITIAL TENSION SPRINGS.

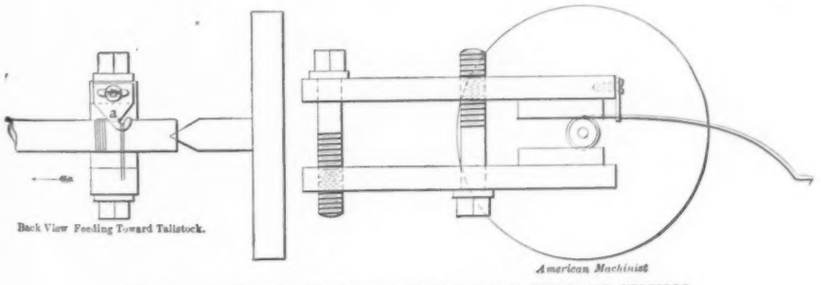


FIG. 2. DEVICE FOR WINDING LIGHT INITIAL TENSION SPRINGS.

Fig. 2 shows a device I have seen in use for winding small set-springs. It is the same in principle as the other, excepting that only light tension is needed. A few coils of spring are wound, then the parallel clamp with fiber jaws is screwed on, and a few more coils wound to bed the wire in the fiber. The wire is then hung on the hook provided at *a*, which can be adjusted to give a hard or soft set. Any length of spring can be wound on the smallest mandrel without springing it. The mandrel in Fig. 2 is shown greatly exaggerated for convenience, and on centers, but in operation is always gripped in the chuck.

TOOLMAKER.

[Several springs were received with the manuscript for this article. They vary in size from ⅛ to 1 inch, and are made of wire from .010 to .125 in diameter. They are uniformly wound and the initial tension is very apparent.—Ed.]

Thumb-Rules—Boiler Manholes.

At page 28, current volume, M. Whitney, from the Hawaiian Islands, adds one more to the series of articles on "squaring mixed numbers." Our Pacific friend does not tell us anything additional to what we already had. I think F. Shaw's article at page 825, Volume 27, is the best one, but I do not intend to say any more about "squaring," and I direct my remarks to the so-called "thumb rules" in general. These, no doubt, are useful and handy devices to relieve us a little from the mental work. The only bad thing about them is that there are too many to be remembered. Usually they do not "stick" to us, and even if they do, we do not realize their advantage in all cases.

Some rules very good for one locality would seem absurd in another place, just like jigs or fixtures, which really are nothing else but another form of "thumb rules." To have real good use of thumb rules, we have to invent them for ourselves when we need them, no matter if they had been already invented a hundred years ago.

Some time ago I read in your esteemed paper about boiler manholes; allow me to tell you my story about one. A good many years ago, in the navy, where I served, I was ordered to clean one of the boilers of a certain gunboat, and so I and a fellow jacky forced our way without trouble into the boiler. My fellow was a good-natured boy, and the only fault I found with him was that his hips were larger in circumference than a standard jacky ought to have; but I did not notice that so much before we went into the boiler. A boiler is good also for a short smoke during the cleaning hours, and we made it as good as possible till the dinner gong.

When we heard the gong we made a dash for the hole. He, my friend, was the first to reach the opening, and up he went as far as his hips, and here is where our common trouble began. He forced himself into such an unfortunate position that he could go neither up nor down. I, from the inside, helped him as much as I could till he started to cry "murder," "help," and made certain motions with his legs which I quickly understood. Then I stopped helping him and crawled on top of the tubes and waited developments.

Naturally all the boys, after the gong struck, had run up the way to the washroom, and so it was some time before somebody realized our trouble, during which I had ample time to think a lot about boilers and their makers. I omit

these thoughts, except the one about the size of the hole.

Outside the boiler the boys finally cut a piece of sheet iron, something like 15 inches wide, 55 inches long, 1-32 inch thick, rolled it around my friend's body and forced it down between his hips and the hole opening, sometimes against his will, making a sort of a sleeve around his lower body, thus preventing his clothing and body from being squeezed out over the edge of the hole, after which they pulled, and I pushed, and we got him out of my only way to freedom. I had no trouble in getting out, but I think boiler manholes could be made larger.

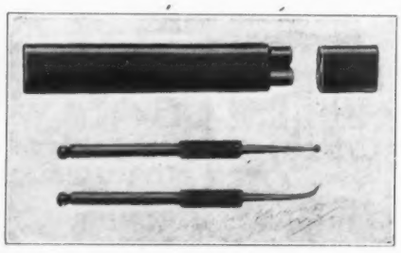
S. I. OESTERREICHER.

A Drilling and Reaming Jig.

Having occasion to drill a number of holes in gray-iron castings *A*, which were made in pairs, right and left hand, the jig herewith described was designed. Driven into a gray-iron block *B*, flush with both faces, are bushes, which are rounded out to admit the drill either way. The cams *C* and locating pins *D* are conveniently placed, the pins projecting on both sides of block *B*. To support the casting to be drilled, the machine-steel plate *E* is provided; this is held in position by screws *F* and wing-nuts. The pins *G* serve to locate the plate in relation to block *B*. In the plate are rectangular holes to admit the heads of screws *F*, and drilled holes to permit free passage of drill or reamer. The casting to be drilled, whether right or left hand, is placed on the corresponding side of the jig; next by means of the cams *C* the work is located and tightened against the pins *D*, and finally to support the work against the drill pressure the plate *E* is slipped over the heads of screws *F* and drawn up by wing-nuts. In order to drill castings of the other hand, plate *E* is removed, and after screws *F* have been reversed, replaced on the opposite side of the jig, the operator then locating the work as before. In conjunction with this jig we employ the drill adapter *H*, by means of which we are enabled to use bushings of uniform size, and also by reducing their length, minimize the risk of breakage on small drills. This jig has been in constant use for two years and has "made good." C. F. H.

Instruments for the Shop Eye Doctor

Every machinist, I suppose, knows what a painful experience it is to have a hot chip in his eye and the process of removing the intruder is more painful still to many. I have cleaned such motes out of a great many bad eyes after removing the beams from my own.



INSTRUMENTS FOR THE SHOP EYE DOCTOR.

After poking around with matches and magnetized wires trying to extricate the tormentors and suffering more from self-inflicted injuries, I made the little tools shown in the photograph. They are made of cast steel, about 3½ inches long and 3-16 inch diameter. They are hardened on the ends and magnetized. The one with the ball point is very handy for removing loose or floating chips, while the other, which has a scalpel-like point is just right to lift any particle that may be stuck on or imbedded in the eye. The latter is much to be preferred to a scratch awl, however skillfully the scratch may be wielded. The nurling is an aid in holding them and they seem to hang about right when one's fingers rest on the cheek. The hard-rubber case makes it convenient to carry them in the pocket.

GEO. W. ARMSTRONG.

A Recessing Tool.

Fig. 1 shows a plain round piece of steel threaded and relieved in the middle. The problem was to make it a screw machine job rapidly and easily machined from the solid bar, the difficulty being in relieving the threads at the center without using a very delicate boring tool. The hole to be drilled was only 5-16-inch in diameter (afterward tapped ⅜-inch), so the ordinary boring tool was too light to permit the desired speed, and as the parts were made in large lots, time was quite a consideration.

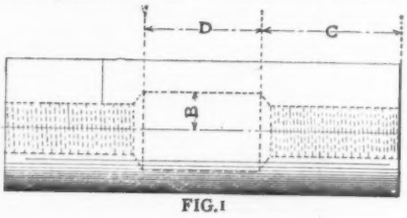


FIG. 1

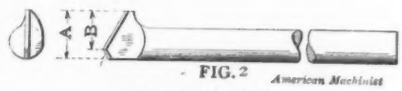
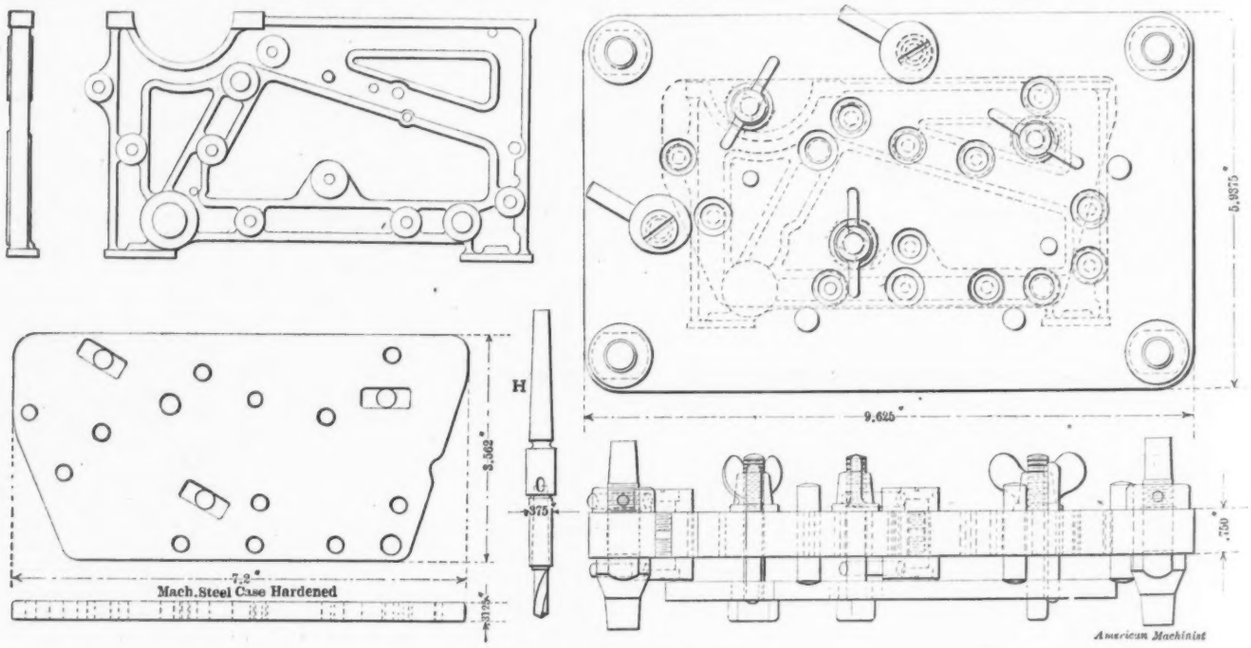


FIG. 2 American Machinist

RECESSING TOOL.

The tool shown in Fig. 2 was devised for the job and upon trial proved ideal



A DRILLING AND REAMING JIG.

This tool has the point ground off center as shown, and is held in a floating chuck to allow the point to center itself with the work. *A*, Fig. 2, must be slightly smaller than 5-16-inch. *B*, Fig. 2, must be the same as the dimension *B* desired, in Fig. 1.

The first operation is drilling the 5-16-inch hole to the depth of *C*, Fig. 1 The drill is then withdrawn and the tool in Fig. 2 is inserted, the point of which moves toward the center of the hole by reason of the angle made by the point of the drill. This cuts the clearance desired, which is continued the length of *D*. The tool is then withdrawn, and the hole tapped. The piece is cut off the bar and the hole is tapped in the opposite end in another operation.

It is plain that the less this tool has to cut out, the better it will do the job. The sketch shows the principle exaggerated in order to illustrate it more clearly, the idea being to relieve the hole only enough to clear the thread. The pieces machined are used for turnbuckles.

L. F. B.

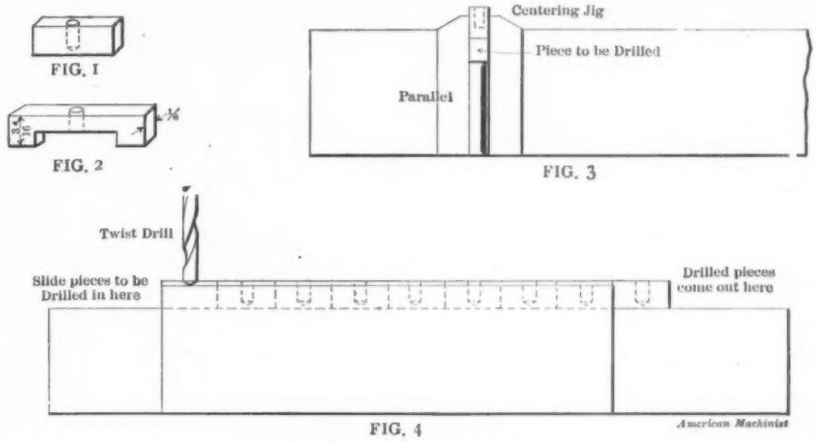
Tools for Making Washers on the Automatic.

These tools are for 7/8-inch washers, 1/8 inch thick, with 13-32-inch holes and chamfered on one side. The largest of the set of cutting-off tools is 3 inch diameter; the second, 2 7/8 inch; the third, 2 3/4 inch; the fourth, 2 5/8 inch. Each is 3-32 inch thick, has a 1 1/4-inch hole, with keyway, and is hardened and ground. The spacing washers are the same thickness as the washer to be made, and all are assembled on a sleeve as shown, the distance from the face of the collar to the end being 1-64 inch less than the total length of tools and spacers to enable the tools to be drawn up to the side of the tool post. The chamfering tools are made and held in similar manner. They are made for a Brown & Sharpe No. 2 automatic forming machine, the cross slides being made in two parts and operated by separate cams, enabling front and back tools to be operated at the same time. The chamfering tools get through with their operation first and return to their former position. The first washer cut-off being on the outside, drops off and the remaining three are held between the tools until released by the knock-out lever *A*, which is shown in position. The collar on the rod is set to bring the lever to the edge of the cut-off tools, or a little inside to keep it from getting caught on the front of the tools. The spring will pull the lever back against the spacing washers when the tools proceed to the next cut. The small angle iron *B* is 1/8-inch sheet steel, 7/8 inch wide, and held, as shown, under the head of the tool-post bolt.

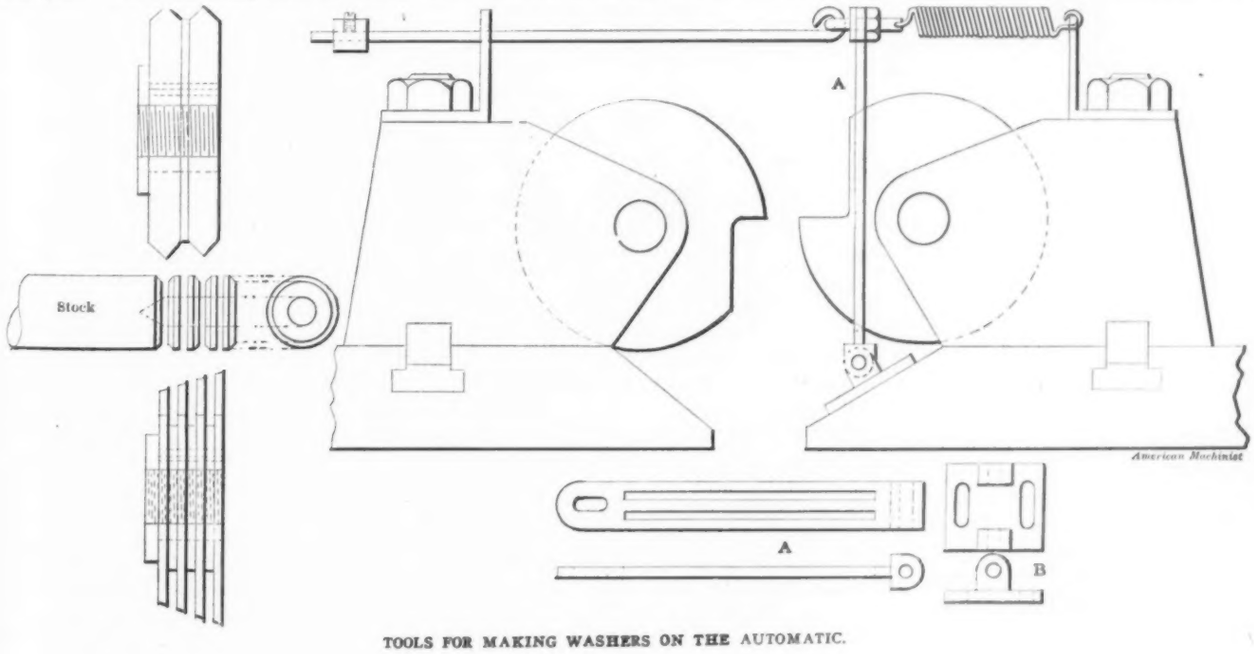
The machine has two sets of tools in the turret, and the cams are cut double; so we get eight washers for each revolution of the turret. The time required to make each washer is 6 1/4 seconds. McK.

Drilling Small Steel Blanks.

Very often in manufacturing it is necessary to make up, say, from 100 to 300 pieces of a certain kind quickly, and where, as is often the case, it is doubtful whether the piece will become a permanent factor in the make-up of the mechanism, it is unwise to make expensive jigs or dies at the start. Fig. 1 shows a piece of this kind. A screw fits into the hole without shake and the piece has to be made very nearly right, as the diameter of the hole is about equal to the width of the work. Fig. 2 is the centering jig, which is merely a piece of the same material, 1/8 by 3-16 inch mild steel, shaped as shown and case-hardened. Fig. 3 shows how the centering jig was used in a plain vise, and Fig. 4 shows how the pieces were slipped between the vise jaws and drilled to proper depth by setting the stop on the drill-press spindle. The vise jaws were set so the pieces had about 1-64 inch side play, this making it possible for them to center themselves nicely.



DRILLING SMALL STEEL BLANKS.



TOOLS FOR MAKING WASHERS ON THE AUTOMATIC.

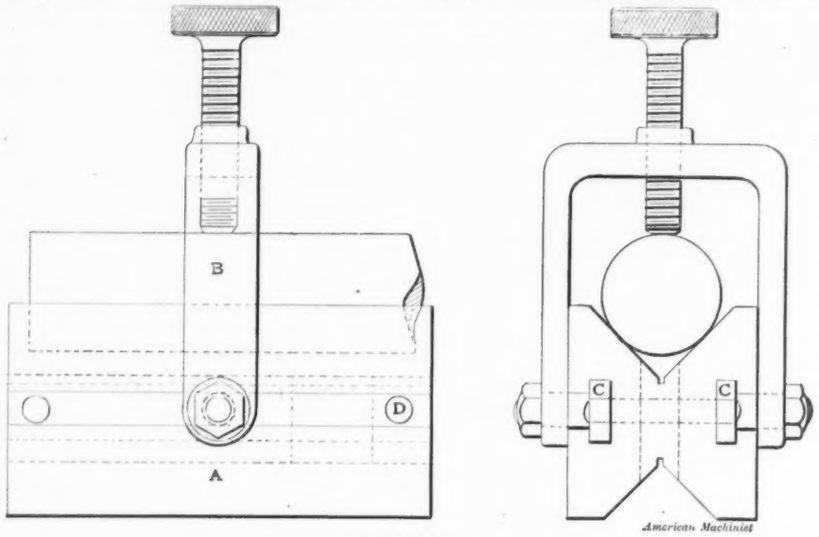
Having no thin parallel, I used a thick scale, which served the purpose very well without being injured.

ROBT. A. LACHMANN.

A V-Block.

The sketch shows a small tool which is very easily made and it is as handy a tool as I have in the shop. It is a V-block for holding small shafting. *A* is the block having two T-slots milled, one on either side, and *B* carries the clamp screw and is fastened to the V-block by two screws *C* whose heads fit in the T-slots. These screws will allow the clamp to swing on either side, so as to hold large or small shafting. *D* is a pin that is put at each end so as to keep the clamp from sliding out of place. It will be noticed that there is a slot cut in the V-block to let the drill pass through.

P. W. OLSON.



A V-BLOCK.

Machining Cast-Steel Boxes.

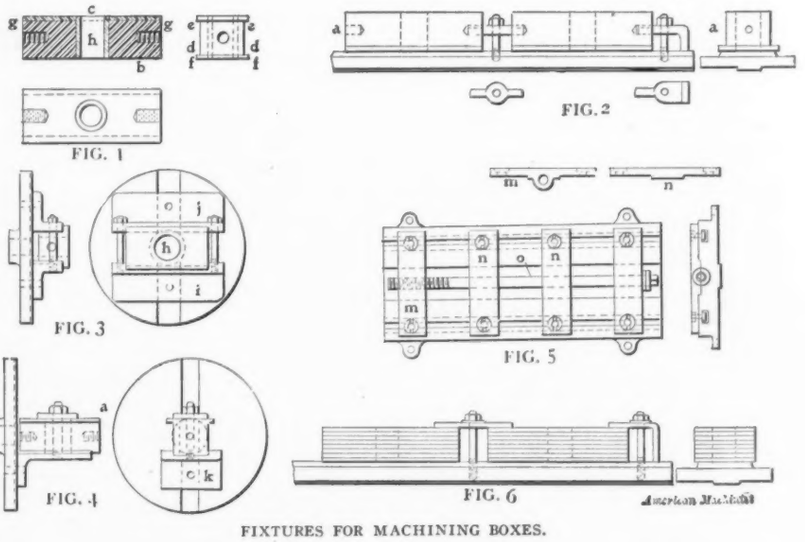
The accompanying sketches show a method of machining cast-steel boxes, such as are used in the valve motion of duplex, compound or triple-expansion pumping engines.

Fig. 1 represents the box which is finished all over and brass bushed. The boxes are first drilled at *a*, Fig. 2, to admit the straps which secure them to the milling fixture. The holes are laid out carefully, and are of a size and depth to allow of reboring and tapping. Faces *b*, Fig. 1, of the boxes are then milled. Then, by using a combination of milling cutters, faces *c* and *d d* and the sides *e e* are milled at one time. The following operation is the milling of the edges *f f*, using the same fixture, and the next the milling of ends *g g*. Then the hole *h* is bored. Two angle plates, Fig. 3, that fit the face-plate are used. Angle plate *i* is planed out for a seat in which the boxes fit and is stationary on the face-plate, while angle plate *j* has to be slightly moved to allow the finished box to be removed from the machine, and then refastened to hold the next box to be bored. The tools used are a double cutter and a reamer. Fig. 4 shows the rig for boring and tapping the holes *a*, angle plate *k* having a pocket planed out to receive the boxes.

To face both sides of the box followers, a vise, as shown by Fig. 5, may be used. It is very simple in construction and can be used to hold any kind of flat, thin pieces, as its jaws can be designed to hold pieces of circular, elliptical or irregular outline. The jaws are made of tool steel and fit the body *l* that fits the table of the milling machine. One end jaw *m* is threaded for the screw, and the other end jaw is bored to allow the screw to turn free. The intermediate jaws *n* are plain. The followers are put between the jaws, which are lightly tightened by means of the screw *o*. Then the clamp screws in the jaws, and screw *o* are alternately tightened until the followers are firmly held. The sides of the followers are then milled, a number at a time, as in Fig. 6, using the fixture shown in Fig. 2. The boring of the followers may be done on the rig shown in Fig. 3. They fit the seat planed in the angle plate and rest against the face-plate. Of course several are bored at one time, using a double cutter and then a reamer.

In this way the boxes are machined in very fast time, and they all come uniform in size and therefore are interchangeable.

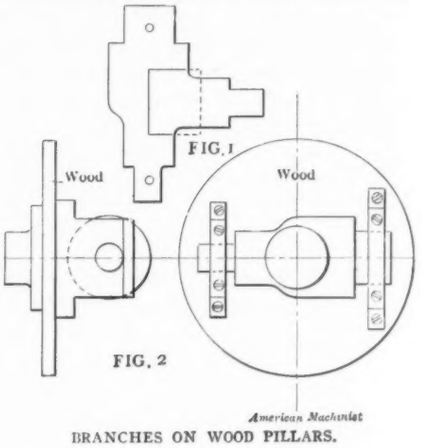
J. M. MENEGUS.



FIXTURES FOR MACHINING BOXES.

Branches on Wood Patterns.

In making patterns of cylindrical pieces having branching parts, a quite common method is to fit the branch up against the body of the pattern; to cope it on, as the patternmaker would say. On pattern work for but a few castings, or on large work, this may perhaps be the best way; it usually has the merit of being at least the quickest. But on standard patterns which are to be used year after year this method of construction is open to serious objections. In the first place, the fillet, which is necessary to ease off the sharp corner where the branch joins on to the body, has to be made of putty, leather or some equivalent material. Putty in time cracks and crumbles out, and the glue which holds the leather softens in the moist sand of the mold and allows the edges to



BRANCHES ON WOOD PILLARS.

curl up. A branch so fastened on is also likely to work loose.

For these reasons a better way on patterns which are to do much service is to let the branch into the body as in Fig. 1, which shows the inner face of one-half of the pattern, having the branch large enough where it enters the body to allow of working out the fillet. The dotted lines show the shape the branch is turned, the fillet being worked by hand. This gives a durable construction and a fillet which will not come out. On good work the additional expense is money well invested. In cases where the branch comes on to a part of the pattern which is not straight, as in the case here shown, it is doubtful if there would be much difference in the cost anyway, as the work of fitting the branch on to such a place by hand would be considerable.

Fig. 2 shows a method of mounting the pattern body on to a faceplate, so that the place to receive the branch may be turned out in the lathe, thus getting the best work in the least time. F. L. S.

A Novel Tool Chest.

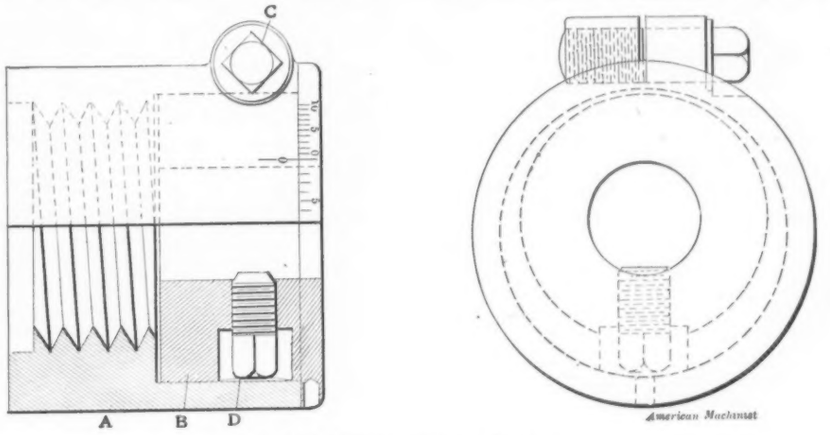
Having tried my patience with the inconvenience of many different styles of tool chests, I felt disposed to use a little spare time and make a chest as shown in the illustration. It will be noticed that the lid is hinged in the middle, and when opened gives ready access to any of the drawers. The spring lock is placed at the lower right-hand corner of the lid, the shallow drawer below being locked with a spring plunger which is pressed down by a brass knob on the edge of the lid. The chest is made of black walnut, being highly finished and lined throughout with purple velveteen. R. D. SMITH.

A NOVEL TOOL CHEST.

A Boring-Tool for the Miller.

The accompnaying sketch shows a tool which is a very convenient attachment to a jobbing shop or tool-room milling machine. It is designed to hold a regular round boring bar with inserted tool held by set-screw or other means.

A is a casting which is threaded at one end to fit the nose of the milling-machine spindle and bored at the other end to receive piece *B*. The threaded end of *A* and the end into which *B* fits are eccentric to each other about 1/8 inch. *A* is split from the front end up to the threaded part and has a binding screw *C* for securing *B* in position. The boring bar is carried by *B* (which is graduated on the outside) and is secured by set-screw *D*. The hole into which the boring bar fits is bored eccentric to outside of *B*, so that when the parts are assembled with *B* set at zero, as shown, the bar will run true.



A BORING TOOL FOR THE MILLER.

In using this fixture the bar is inserted in holder *B* and allowed to project the required distance, when the inserted cutter may be set to bore a hole of approximately right diameter, and further adjustment for cuts made by turning *B* in *A*. Several bushings may be made for part *B* to accommodate different diameters of bars and all bars made comparatively long, as any length not required on a particular job may extend back into the hole in the milling-machine spindle.

This tool gives a quick and fine adjustment for cut and has the further merit of being inexpensive.

M. B. F.

Apprentices in England.

The apprentice question is one that is always with us, and, after the letter of Entropy at page 742, I propose to give my experience in this line. The apprentice indentured for a term of years may be said to be a failure; simply for the reason that in nine cases out of ten a boy will take liberties with the work and the people in charge which he would not do were he liable to instant discharge for misconduct.

The general definition of the term apprentice in England is that of an unindentured boy who comes into the shop to learn a trade, and it is of this class I write as apprentice. There will always be work in every shop for boys; and the question of whether their work can be made to pay may safely be answered affirmatively, I think. How to get the work out of them is a question for the foreman. To do this he must be highly skilled as a mechanic; not for the reason that he will be called upon to use his utmost in showing a boy how to tackle a job, but a good mechanic as a foreman is respected by the men in the shop, and, consequently, when, say, he picks up a file to show a lad how to do a job there are no side glances or laughing up sleeves. In this connection I may mention that when I took up a foreman's job some time ago one of the questions I was asked was, "What sort of a workman are you? We want a first-class workman, because

we want a man who will be respected as such." Afterward I learned that the previous occupant of the position had not, in the six months he was there, been known to use a tool of any kind.

But, to get back to the boys: When you are called to the front door to see a boy, it is pretty hard to size him up, harder than with a man. Sometimes nervousness seems to depreciate boys' likeliness 50 per cent., and, like men, they suffer from the big head also. "Oh, yes! have been elsewhere." "How long?" "Six months." "Cause of leaving?" "Shortness of work." Give this sort the go-by. No boy worth his salt is sent away for shortness of work. After some actual experience I have given up this type. Another rule I have come to observe is never to re-engage a boy who has been discharged for what, after the lapse of a year, may seem a trifle. Another rule is not to have relatives of fellow-employees, especially office people.

Now, I propose to make an assertion which may seem somewhat of a paradox. You get better service from boys in places which are non-mechanical in their industries than from those in manufacturing centers. This is due, I think, to the fact that a boy, after a year or two in the shop, realizes that there is some responsibility or risk in being out of work. It may mean moving to another town if he means to keep his trade.

After some little experience in handling boys and men, I think that boys, properly managed, are a paying investment to any machine shop. An apprentice of about three years in a shop, if he is smart (and it is up to the foreman to see that only the smart ones are in the shop) is more valuable than the average journeyman who is taken out of the street. J. C.

A Blanking and Shaving Die.

I enclose sketch and a section of scrap with several blanks that have been punched through a system of dies that, as far as I know, are original. The object of a die of this kind is to save the cost of material, sub-press and shaving dies at once and also to avoid the expense of handling the parts one at a time through a separate shaving die.

Blocking out an opening at the point of outline desired shaved (the ear at the end of the piece, Fig. 1) enables you to fit your blanking punch snugly at this point, and of course practically makes a shaving operation as the blank passes through the die. *A* and *B*, Fig. 2, are inserted plugs for convenience in working out the die, and with these you have no shrinkage to contend with, which is important, as, in order to make a smooth job of shaving on our stock, about .003 is all you can allow without getting a break.

A very good stop is also shown in the sketch. The object of this is to leave nothing to the judgment of the press hand in starting the strip through, and there is no chance of his getting the end of the strip half under some small punch and throwing it over against the edge of the die. He is supposed to slide the strip in as far as it will go and push the stock continually forward. The location of the stop is not necessarily very accurate, as it has lost control of the strip altogether when the pilot pins have entered, thus allowing the stock to adjust itself to suit the pilots.

These dies have been in use at the Universal Adding Machine Company's shop for the past six months, giving satisfactory results. THOS. E. HEETER.

St. Louis.

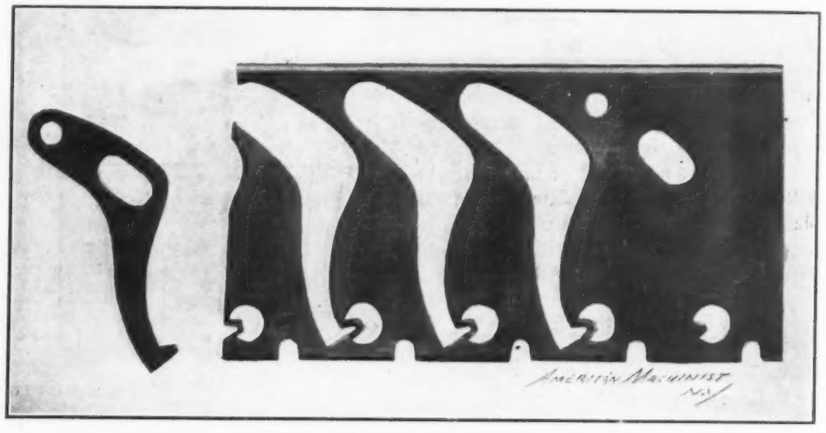


FIG. 1. THE WORK AND THE SCRAP.

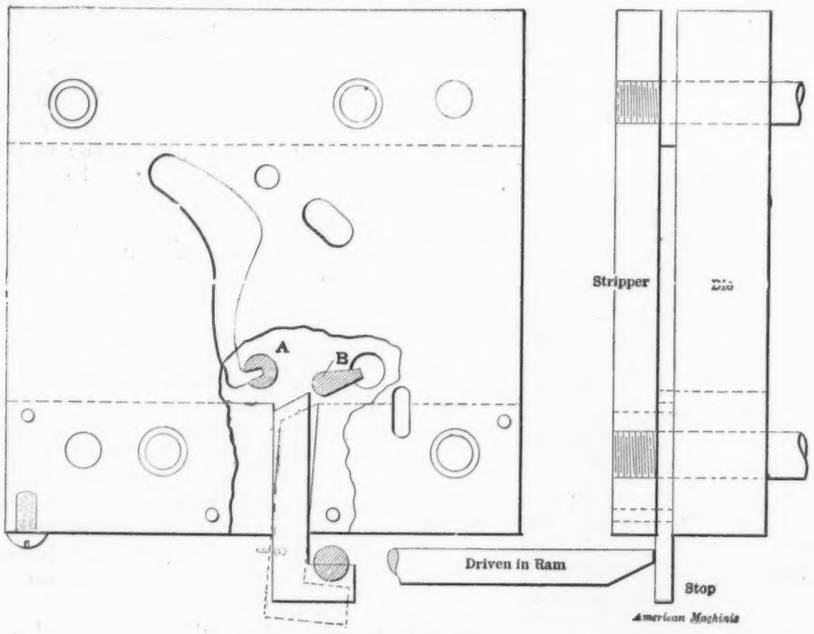


FIG. 2. THE DIE.

William T. Carnes, while working in a machine shop at Pittsburg had his right arm crushed so badly in the gearing of a boring-mill that amputation above the elbow was necessary. He turned his misfortune to good account, however, by devising an artificial hand, the fingers of which are so jointed as to be opened and closed in much the same fashion as those of the human hand, and now manufactures the appliance at Harmonsburg, Pa., having a well-equipped machine shop in which he makes the necessary mechanism. This artificial limb is so well developed that Mr. Carnes ties his neckties, carries a heavy satchel and does many other things in much the same manner as before he met with the accident.

The sailing ship is rapidly becoming obsolete, and promises before long, except for pleasure purposes, to be extinct. A greater tonnage of sailing ships is either lost at sea or broken up than the tonnage built, and the sailing vessels in the shipbuilding yards decrease every year. On June 30 there were 4,831 tons of sailing ships building in the United Kingdom. Three years ago the tonnage of sailing ships building was 26,840, so that in this period the tonnage building has dwindled to about one-sixth.—*The Mechanical Engineer.*

Echoes From the Oil Country—A Way to Keep From Worrying.

"I have been so worried that I haven't had time to think, scarcely," said one of the group.

"Some of the things that come along are enough to make anyone worry," added another.

"I feel sorry for you fellows, I must say," said a man who was just then superintendent at one of the shops.

"You get that out as if you never worried any yourself," returned one of the first speakers.

"I don't. I don't have to. I guess you are not 'next' to yourself yet or you wouldn't either," said the superintendent.

"I suppose you take in everything that comes along?" asked a man who had not spoken before.

"Of course we do. If you have anything that these other fellows are afraid of bring it over to our place and get it done," said the superintendent.

"I will be around at your place in the morning. I have a job that I was afraid might be a little troublesome, and it has worried me a little to find a place to get it done. I am glad that I happened along just when I did." This man was always "getting up" something, and seemingly some of the things were not easy to make, for his remarks seemed to amuse one of the first speakers. He ran a machine shop of his own and was not always able to get along without worrying, as his friend the superintendent claimed to be able to do.

These men had met on the street in the evening, after the day's work was over, and soon each one went his own way.

Soon after the superintendent arrived at the works the next morning he was greeted by the man who wanted something done. The owner of the other machine shop also happened to be present.

"I am glad I ran across you last night," said the man with the job. "Some of these fellows are always wanting a job changed. They think it would be so much better if it were this way or that way, or it wouldn't cost so much if it was made that other way, or something else. I always pay for everything I get done, and like to have things done as *I* want them done, and then if things don't work I know who to blame."

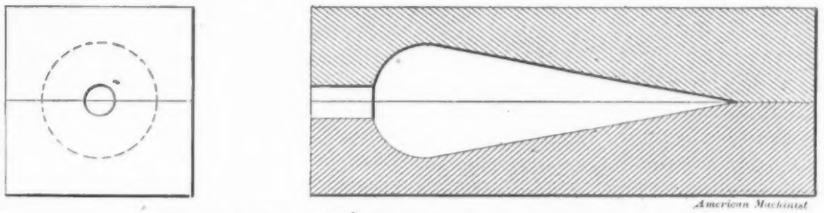
"I plead guilty, and dropped over to see how you will handle this job without worrying," said the owner of the other shop.

"Let me see that job and I will show you how it is done," said the superintendent.

Two pieces of tool steel and a sketch were quickly produced. One side of each of the pieces of steel had been planed off, and now this man wanted a form cut on the inside of them like the sketch. I cannot give the exact dimensions, but the blocks were about 15 inches long, the shank of the form wanted 1 inch in diameter, the largest part about 5 inches in diameter, and it ran down to a fine point. One-half of this form was to be in each piece of the steel.

The superintendent glanced at the sketch, told a laborer to put the steel on a truck and follow him with it, and turning to the others said, "If you will kindly step this way with me you will see why I do not worry any," and started down through the shop. He stopped before the foreman of the machine gang.

"Mr. Smith, here is a little job of machine work that this gentleman wants to get done. Here is a sketch showing the general idea. He will tell you what he wants in the way of finish, and so forth, and there is the steel. Be careful to do him a good job, and do it just as he wants it done. I understand that he has had some trouble getting his work done in the other shops as he wishes it. I know that you are not afraid of any kind of machine work, and told him to bring it here and we would do it, and do it as he asked to have it done without hinting that we know his business better than he does."



THE JOB THAT DIDN'T WORRY THE SUPERINTENDENT.

The superintendent evidently felt that he was through with that part of the shop for the time being, and started to walk away while Mr. Smith was being filled up with the details.

"If anyone worries about that job it will be Smith, and not me," he remarked. "He at least thinks he knows a lot more about machine work than I do, and I don't care what he thinks as long as he gets the work out, and he will never come near me to ask for any advice or help, so what is the use of me worrying."

Anyone going by Mr. Smith's part of the works in the next few days could see that he was in deep thought much of the time and if he was not worrying he was doing something that would pass for it among any but the most expert worriers.

I am sorry to say I cannot tell you how that job was done, or what kind of a job it was after it was done, or whether the man was better pleased than he had been at the other shops. I do not know these things, but do know how some people keep from worrying about some things. They make the other fellow do the worrying.

That is a good enough way to do if the worry really belongs to the other fellow.

The sketch does not show all of the details of the job, but it will give a general idea of what was wanted.

W. OSBORNE.

Purchase of John Bertram & Sons Co. by the Niles-Bement-Pond Co.

For some time past various items have been appearing in Canadian and other newspapers to the effect that there were rumors of the purchase by the Niles-Bement-Pond Company of the John Bertram & Sons Co. machine-tool building establishment, of Hamilton, Ont. Until recently, however, negotiations had not progressed sufficiently to be sure that such a purchase would be effected, and it is now pretty certain that the published reports to the effect that the Bertram works will immediately be greatly enlarged and improved are not true. The intention is to operate them, for the present at least, in about the same way they have been operated for some time past. The Bertram tools, within the past few years, have acquired an excellent reputation, not only in Canada, but they have built up some trade in England as well, and the Niles-Bement-Pond Company, by purchasing this establishment, is following the course which has been pursued by a number of other American manufacturing concerns which have either built and organized, or purchased Canadian manufacturing establishments in their lines, in order to take care of Canadian and other foreign business.

An Exhibition in France.

Consul Atwell, of Roubaix, France, writes of an international exhibition to be held at Tourcoing, and quotes the Director General as follows:

"We shall appeal to the great constructors of machinery in England, America and Germany. They will bring to us their perfected machines, and we may then select for our national industry all that is best calculated to advance its interests. Machines will be in operation from 2 o'clock until 5, and will be far more instructive than the inert looms which we saw at the Paris Exposition in 1900. Sections are to be reserved for chemicals and for articles of every kind appertaining to agriculture. There will be exhibits also of carpets, furniture, and draperies."

The "Vermont," another 16,000-ton battleship for our navy, was launched August 31 at the yards of the Fore River Shipbuilding Company, Quincy, Mass.

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Contents.

	PAGE
Modern Pipe Founding	303
American Goods Better Packed than English	308
Some English Tools	310
Pioneer Engine Building	314
A Confederate Patent for a Breech-Loading Gun	315
Up-to-Date Method of Molding	316
Studies in Inventive Problems—X	319
Letters to the Editor	326-334
Echoes from the Oil Country—A Way to Keep from Worrying	335
Purchase of John Bertram & Sons Co. by the Niles-Bement-Pond Co.	335
An Exhibition in France	335
A Secretary of Manufactures	336
The "Bennington" Disaster	337
Standard Specifications	337
Determining the Position of Idler Pulleys for the General Case of Belt Transmission—Erratum	337
New Tools and Machine Shop Appliances	337
Experiences of the Repair Man	338
Eighteen Liners for Japan	338
Manufacturing Cannon for the Japanese	338
Making the Pattern and Mold for the Side of a Power Screw Press	338
Files and the Scrap Heap—Tools from Old Files	340

A Secretary of Manufactures.

The president of the Trans-Mississippi Congress, speaking of the mining industry of the United States, advocated the appointment of a Cabinet officer, with the title of Secretary of Mining, and thereupon the discussion of the possible or practicable number of members of the President's Cabinet is being again discussed, and the genius is referred to who occasionally persuades some Congressman to introduce (by request) a bill for the complete re-organization of the governmental machinery, and which provides for a Cabinet consisting of something over 60 members; one of them being called—the "Secretary of Public Fluids" and another the "Secretary of Public Amusements."

We ourselves do not advocate (nor oppose) the addition of secretaries to the Cabinet, but we do believe that the Secretary of Commerce and Labor should have been called the Secretary of Commerce and Manufactures, or possibly just plain Secretary of Manufactures, and that he should have had full charge of all manufacturing work carried on by or for the Government of the United States. Many years ago the AMERICAN MACHINIST advocated the addition of such an officer to the Cabinet, and pointed out the advantages that would accrue from the possession of such an officer in the President's official family. It is our belief that to have each of the various departments of the Government, such as the Treasury Department, the Post Office Department, the Army, the Navy, etc., carrying on and looking after its own manufacturing affairs, is a wasteful and very inefficient plan, and that it would be much better to have an officer whose title might be as suggested above, and who should have charge of all such matters. He would naturally be selected for his acquaintance with manufacturing operations, and for his supposed efficiency in carrying them on. He would, let us hope, be able to secure as efficient, or nearly as efficient, manufacturing of small arms, of mail bags, of naval vessels or of artillery as could be secured by a private concern, because he would be first a skilled and experienced manufacturer, familiar with the methods by which manufacturing is done where close account must be kept of cost, and where the manufacturer's product must go into the market and compete with other similar products.

A great many queer things are now done in the various manufacturing establishments carried on by the Government; things that would seem almost incredible in a country so skilled in manufacturing operations as is the United States. These things are not chargeable to or to be blamed upon the men who carry on these manufacturing operations, but are due to what we believe is a wrong system. We can see no reason why a man who has ought, of course, to know what a gun should be expected to do, and probably also how it should be designed to accomplish that result, but supposing the design to be complete, it is simply ludicrous to assume that in a country such as this, he is the one, or the only one, who should then be trusted with the responsibility of making the gun. That is a manufacturing problem, pure and simple; for the solution of which we have men in abundance in every manufacturing center who are at present carrying on such operations, and who would be glad to render service to the Government for a term, and for a fair salary, in view of the honor which ought to, and probably would, attach to public service of that character. That various departments of the Government should maintain practically duplicate plants and organization for carrying on similar work is, to say the least of it, unnecessary, and that the numerous bureaus of the navy should each have its own manufacturing plant or department, equipped in many cases with tools and appliances, duplicates of those of other bureaus, is absurd and violates well-established principles of economy in manufacturing operations. We believe that the manufacturing work of the Government should be organized upon business principles, that the various departments should specify what they want, and how it is to perform the service expected of it; that it should then depend upon the Department of Manufactures to produce the things desired, and that the man to be at the head of such a department should be one skilled and experienced in carrying on manufacturing operations; that he should be also a member of the Cabinet, with the title of Secretary of Manufactures, though, of course, the functions of carrying on manufacturing operations might properly be given to the Secretary of Commerce and Labor.

The United States Government not only carries on manufacturing operations upon an extensive scale, but it contracts with private manufacturing concerns for amounts reaching many hundreds of thousands of dollars annually. Most of this work is conducted by men who, whatever their natural and acquired abilities may be, certainly have not had anything like the training and experience that in private life would be considered essential to success and which really are essential. It is because there is no co-ordinated organization and no one at the head who understands how to carry on manufacturing operations that so many queer things happen in connection with the inspection of naval vessels being built in private shipyards.

Most of the military officers who have been placed in charge of our various arsenals have acquitted themselves very creditably, considering the circumstances,

facturer is put in charge of manufacturing operations carried on by or for the Government.

The "Bennington" Disaster.

Since writing as we did last week of the "Bennington" disaster, it transpires that Secretary Bonaparte has refused to accept the findings of the court of inquiry and has ordered that the commander of the "Bennington" shall also be tried by court martial. We venture to predict that it will be found that the commander of the vessel is very little, if at all, to blame for the disaster. It is the system. It has been repeatedly prophesied by men competent to judge that the abolition of the engineer corps and the manner in which the personnel bill has been working, would insure, sooner or later, a disaster such as occurred on board the "Bennington." It is about as certain as anything can be, that there must be a competent engineer corps to take charge of steam-engineering matters connected with the navy, and that the men composing this corps must have control of affairs within that department, which control must be fully commensurate with their responsibility. There can be no half-way stopping point in this matter if smooth working and efficiency are to be attained.

Say what we will, the fact remains that the condition of affairs revealed by the "Bennington" disaster would have been simply impossible if a competent engineer had been in charge of that department of the vessel, and if that engineer had had the authority he ought to have; an authority fully covering those things for which he is supposed to be responsible and must be held responsible before things can be on anything like a satisfactory basis in the United States navy.

Standard Specifications.

The American Society for Testing Materials has sent to the membership, with a mail ballot on the adoption thereof, a series of proposed standard specifications for various materials, which include steel forgings, steel axles, gray-iron castings, steel castings, structural steel for bridges and gray-iron car wheels. The specifications are published from the office of the secretary-treasurer, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

Determining the Position of Idler Pulleys for the General Case of Belt Transmission—Erratum.

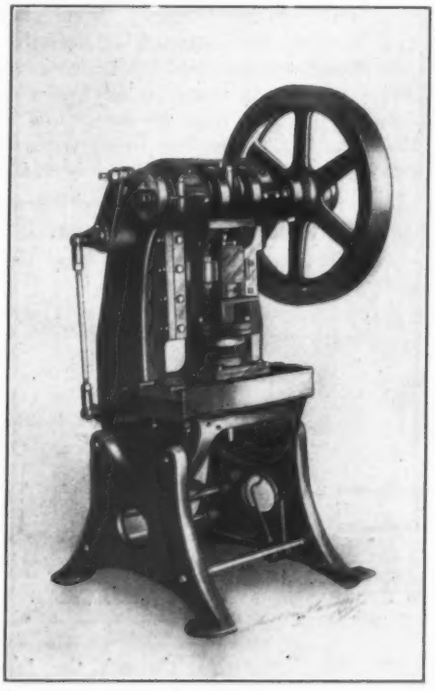
In the title of the above named article, at page 260, *read case* for *care*.

A large steel floating dock was recently launched at the Mitsu Bishi Dockyards, in Japan. It is 397½ feet long by 88 feet

New Tools and Machine Shop Appliances.

DOUBLE-ACTION PRESS.

The accompanying illustration shows a double-aetion cam draw press which can be set in inclined position so that the finished work discharged from the die can drop through the opening in the back of the press. The inclining device consists of a vertical screw and hand wheel. The change from one position to the other is quickly made, without danger of having the press tip too far, as the adjusting screw will hold the frame positively in all positions. The cams, cam rollers and pins for the blank-holder slide are hardened and ground. Grease cups are applied to the cam-roller pins also at the end of the crankshaft near the balance wheel, to insure continuous lubrication. A positive clutch of the sliding-pin type controls the

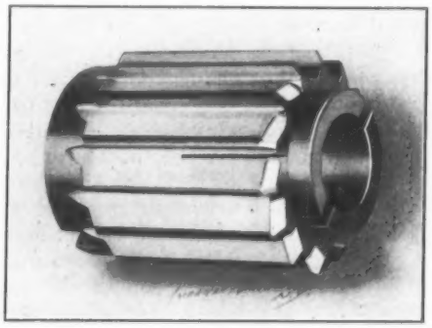


DOUBLE-ACTION PRESS.

motion. Of each revolution, one-sixth is allowed for cutting, one-third for drawing, and during the remaining half of the revolution, the blank holder and inner slide will rise to the upper position. A separate cam mounted outside of the frame of the press is used to raise the blank-holder slide. In some cases, where the finished work is to be ejected upward, a bottom knock-off attachment, as shown in the illustration, is applied. It consists of a rock shaft under the bed, operated by a lever outside of the frame. This arrangement leaves the opening in the back of the press unobstructed. The particular press shown will draw work of light stock up to 6 inches diameter and 1¾ inches deep. The distance from the center of the slide to the back is 6 inches; and from tance to the outer slide is 7½ inches, and the width of the opening of the bed, 14½ inches. The press weighs about 3,100 pounds, and is one of a line recently brought out by the Niagara Machine & Tool Works, Buffalo, N. Y.

EXPANDING SHELL-CORE DRILL AND REAMER.

The half-tone shows an expanding shell drill for use in cored holes, and which, in the 3-inch size from which the photograph was made, will remove ¼ inch of metal on a side. The shell has a standard hole at the inner end to receive a standard shell-reamer arbor, the outer end of the arbor being turned straight to pass through the expanding sleeve. As made in the reamer form, with solid shanks for use in the chucking machine, the tool has



EXPANDING SHELL-CORE DRILL.

a taper expanding plug in place of the sleeve. The maker is the Three Rivers Tool Company, Three Rivers, Mich.

DIAL TEST INDICATOR.

Fig. 1 gives a general view of this new appliance, Fig 2 a sectional view showing its construction, Fig. 3 some uses to which it may be put. Referring to the section in Fig. 2 it will be seen that the stem,

FIG. 1. DIAL TEST INDICATOR.

or push pin, *a*, which comes in contact with the work to be tested, carries at its inner end a wire *b*, which lies in a slot cut crosswise of the boss through which the push-pin passes. The end of the wire or crosspin enters a spiral groove in barrel *c*, and when the push-pin is operated the barrel, through the gearing shown, actuates the indicator point *d*. A spring

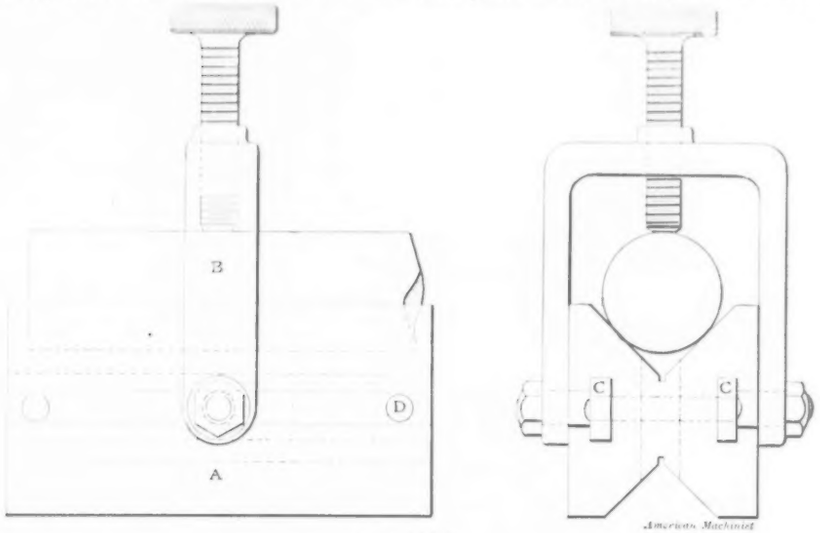
Having no thin parallel, I used a thick scale, which served the purpose very well without being injured.

ROBT. A. LACHMANN.

A V-Block.

The sketch shows a small tool which is very easily made and it is as handy a tool as I have in the shop. It is a V-block for holding small shafting. *A* is the block having two T-slots milled, one on either side, and *B* carries the clamp screw and is fastened to the V-block by two screws *C* whose heads fit in the T-slots. These screws will allow the clamp to swing on either side, so as to hold large or small shafting. *D* is a pin that is put at each end so as to keep the clamp from sliding out of place. It will be noticed that there is a slot cut in the V-block to let the drill pass through.

P. W. OLSON.



A V-BLOCK.

Machining Cast-Steel Boxes.

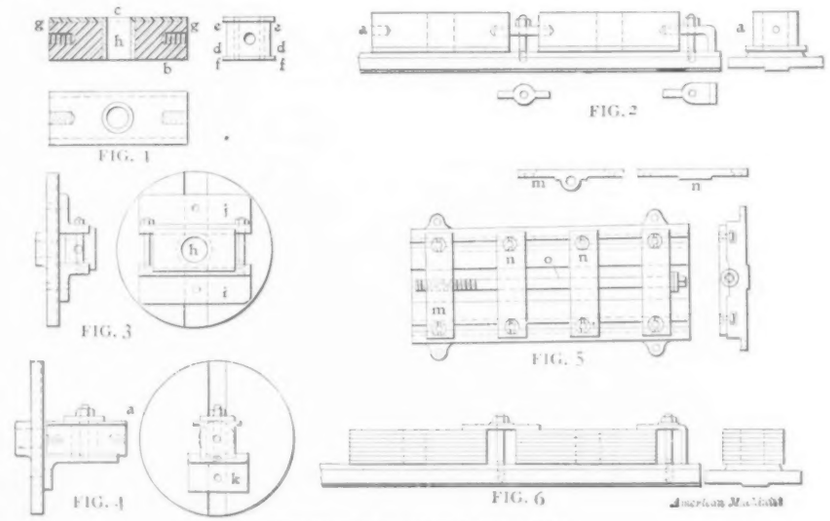
The accompanying sketches show a method of machining cast-steel boxes, such as are used in the valve motion of duplex, compound or triple-expansion pumping engines.

Fig. 1 represents the box which is finished all over and brass bushed. The boxes are first drilled at *a*, Fig. 2, to admit the straps which secure them to the milling fixture. The holes are laid out carefully, and are of a size and depth to allow of reboring and tapping. Faces *b*, Fig. 1, of the boxes are then milled. Then, by using a combination of milling cutters, faces *c* and *d d* and the sides *e e* are milled at one time. The following operation is the milling of the edges *f f*, using the same fixture, and the next the milling of ends *g g*. Then the hole *h* is bored. Two angle plates, Fig. 3, that fit the face-plate are used. Angle plate *i* is planed out for a seat in which the boxes fit and is stationary on the face-plate, while angle plate *j* has to be slightly moved to allow the finished box to be removed from the machine, and then refastened to hold the next box to be bored. The tools used are a double cutter and a reamer. Fig. 4 shows the rig for boring and tapping the holes *a*, angle plate *k* having a pocket planed out to receive the boxes.

To face both sides of the box followers, a vise, as shown by Fig. 5, may be used. It is very simple in construction and can be used to hold any kind of flat, thin pieces, as its jaws can be designed to hold pieces of circular, elliptical or irregular outline. The jaws are made of tool steel and fit the body *l* that fits the table of the milling machine. One end jaw *m* is threaded for the screw, and the other end jaw is bored to allow the screw to turn free. The intermediate jaws *n* are plain. The followers are put between the jaws, which are lightly tightened by means of the screw *o*. Then the clamp screws in the jaws, and screw *o* are alternately tightened until the followers are firmly held. The sides of the followers are then milled, a number at a time, as in Fig. 6, using the fixture shown in Fig. 2. The boring of the followers may be done on the rig shown in Fig. 3. They fit the seat planed in the angle plate and rest against the face-plate. Of course several are bored at one time, using a double cutter and then a reamer.

In this way the boxes are machined in very fast time, and they all come uniform in size and therefore are interchangeable.

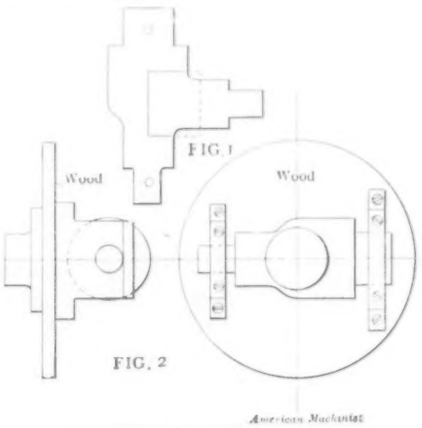
J. M. MENEGUS.



FIXTURES FOR MACHINING BOXES.

Branches on Wood Patterns.

In making patterns of cylindrical pieces having branching parts, a quite common method is to fit the branch up against the body of the pattern; to cope it on, as the patternmaker would say. On pattern work for but a few castings, or on large work, this may perhaps be the best way; it usually has the merit of being at least the quickest. But on standard patterns which are to be used year after year this method of construction is open to serious objections. In the first place, the fillet, which is necessary to ease off the sharp corner where the branch joins on to the body, has to be made of putty, leather or some equivalent material. Putty in time cracks and crumbles out, and the glue which holds the leather softens in the moist sand of the mold and allows the edges to



BRANCHES ON WOOD PILLARS.

curl up. A branch so fastened on is also likely to work loose.

For these reasons a better way on patterns which are to do much service is to let the branch into the body as in Fig. 1, which shows the inner face of one-half of the pattern, having the branch large enough where it enters the body to allow of working out the fillet. The dotted lines show the shape the branch is turned, the fillet being worked by hand. This gives a durable construction and a fillet which will not come out. On good work the additional expense is money well invested. In cases where the branch comes on to a part of the pattern which is not straight, as in the case here shown, it is doubtful if there would be much difference in the cost anyway, as the work of fitting the branch on to such a place by hand would be considerable.

Fig. 2 shows a method of mounting the pattern body on to a faceplate, so that the place to receive the branch may be turned out in the lathe, thus getting the best work in the least time. F. L. S.

A Novel Tool Chest.

Having tried my patience with the inconvenience of many different styles of tool chests, I felt disposed to use a little spare time and make a chest as shown in the illustration. It will be noticed that the lid is hinged in the middle, and when opened gives ready access to any of the drawers. The spring lock is placed at the lower right-hand corner of the lid, the shallow drawer below being locked with a spring plunger which is pressed down by a brass knob on the edge of the lid. The chest is made of black walnut, being highly finished and lined throughout with purple velveteen. R. D. SMITH.

A NOVEL TOOL CHEST.

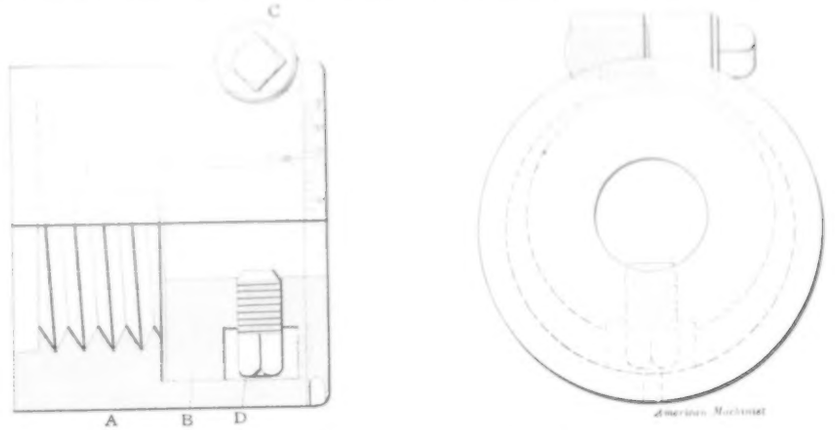
A Boring-Tool for the Miller.

The accompnaying sketch shows a tool which is a very convenient attachment to a jobbing shop or tool-room milling machine. It is designed to hold a regular round boring bar with inserted tool held by set-screw or other means.

A is a casting which is threaded at one end to fit the nose of the milling-machine spindle and bored at the other end to receive piece *B*. The threaded end of *A* and the end into which *B* fits are eccentric to each other about ⅛ inch. *A* is split from the front end up to the threaded part and has a binding screw *C* for securing *B* in position. The boring bar is carried by *B* (which is graduated on the outside) and is secured by set-screw *D*. The hole into which the boring bar fits is bored eccentric to outside of *B*, so that when the parts are assembled with *B* set at zero, as shown, the bar will run true.

In using this fixture the bar is inserted in holder *B* and allowed to project the required distance, when the inserted cutter may be set to bore a hole of approximately right diameter, and further adjustment for cuts made by turning *B* in *A*. Several bushings may be made for part *B* to accommodate different diameters of bars and all bars made comparatively long, as any length not required on a particular job may extend back into the hole in the milling-machine spindle.

This tool gives a quick and fine adjustment for cut and has the further merit of being inexpensive.



A BORING TOOL FOR THE MILLER.

M. B. F.

Apprentices in England.

The apprentice question is one that is always with us, and, after the letter of Entropy at page 742, I propose to give my experience in this line. The apprentice indentured for a term of years may be said to be a failure; simply for the reason that in nine cases out of ten a boy will take liberties with the work and the people in charge which he would not do were he liable to instant discharge for misconduct.

The general definition of the term apprentice in England is that of an unindentured boy who comes into the shop to learn a trade, and it is of this class I write as apprentice. There will always be work in every shop for boys; and the question of whether their work can be made to pay may safely be answered affirmatively, I think. How to get the work out of them is a question for the foreman. To do this he must be highly skilled as a mechanic; not for the reason that he will be called upon to use his utmost in showing a boy how to tackle a job, but a good mechanic as a foreman is respected by the men in the shop, and, consequently, when, say, he picks up a file to show a lad how to do a job there are no side glances or laughing up sleeves. In this connection I may mention that when I took up a foreman's job some time ago one of the questions I was asked was, "What sort of a workman are you? We want a first-class workman, because

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Contents.

	PAGE
Modern Pipe Founding	303
American Goods Better Packed than English	308
Some English Tools	310
Pioneer Engine Building	314
A Confederate Patent for a Breech-Loading Gun	315
Up-to-Date Method of Molding	316
Studies in Inventive Problems—X	319
Letters to the Editor	326-334
Echoes from the Oil Country—A Way to Keep from Worrying	335
Purchase of John Bertram & Sons Co. by the Niles-Bement-Pond Co.	335
An Exhibition in France	335
A Secretary of Manufactures	336
The "Bennington" Disaster	337
Standard Specifications	337
Determining the Position of Idler Pulleys for the General Case of Belt Transmission—Erratum	337
New Tools and Machine Shop Appliances	337
Experiences of the Repair Man	338
Eighteen Liners for Japan	338
Manufacturing Cannon for the Japanese	338
Making the Pattern and Mold for the Side of a Power Screw Press	338
Files and the Scrap Heap—Tools from Old Files	340
Perpetual Motion by Flotation Again	341
Inventions and Designs in India	341

A Secretary of Manufactures.

The president of the Trans-Mississippi Congress, speaking of the mining industry of the United States, advocated the appointment of a Cabinet officer, with the title of Secretary of Mining, and thereupon the discussion of the possible or practicable number of members of the President's Cabinet is being again discussed, and the genius is referred to who occasionally persuades some Congressman to introduce (by request) a bill for the complete re-organization of the governmental machinery, and which provides for a Cabinet consisting of something over 60 members; one of them being called—the "Secretary of Public Fluids" and another the "Secretary of Public Amusements."

We ourselves do not advocate (nor oppose) the addition of secretaries to the Cabinet, but we do believe that the Secretary of Commerce and Labor should have been called the Secretary of Commerce and Manufactures, or possibly just plain Secretary of Manufactures, and that he should have had full charge of all manufacturing work carried on by or for the Government of the United States. Many years ago the AMERICAN MACHINIST advocated the addition of such an officer to the Cabinet, and pointed out the advantages that would accrue from the possession of such an officer in the President's official family. It is our belief that to have each of the various departments of the Government, such as the Treasury Department, the Post Office Department, the Army, the Navy, etc., carrying on and looking after its own manufacturing affairs, is a wasteful and very inefficient plan, and that it would be much better to have an officer whose title might be as suggested above, and who should have charge of all such matters. He would naturally be selected for his acquaintance with manufacturing operations, and for his supposed efficiency in carrying them on. He would, let us hope, be able to secure as efficient, or nearly as efficient, manufacturing of small arms, of mail bags, of naval vessels or of artillery as could be secured by a private concern, because he would be first a skilled and experienced manufacturer, familiar with the methods by which manufacturing is done where close account must be kept of cost, and where the manufacturer's product must go into the market and compete with other similar products.

A great many queer things are now done in the various manufacturing establishments carried on by the Government; things that would seem almost incredible in a country so skilled in manufacturing operations as is the United States. These things are not chargeable to or to be blamed upon the men who carry on these manufacturing operations, but are due to what we believe is a wrong system. We can see no reason why a man who has been educated as a soldier should be presumed to know how to make a gun. He ought, of course, to know what a gun should be expected to do, and probably also how it should be designed to accomplish that result, but supposing the design to be complete, it is simply ludicrous to assume that in a country such as this, he is the one, or the only one, who should then be trusted with the responsibility of making the gun. That is a manufacturing problem, pure and simple; for the solution of which we have men in abundance in every manufacturing center who are at present carrying on such operations, and who would be glad to render service to the Government for a term, and for a fair salary, in view of the honor which ought to, and probably would, attach to public service of that character. That various departments of the Government should maintain practically duplicate plants and organization for carrying on similar work is, to say the least of it, unnecessary, and that the numerous bureaus of the navy should each have its own manufacturing plant or department, equipped in many cases with tools and appliances, duplicates of those of other bureaus, is absurd and violates well-established principles of economy in manufacturing operations. We believe that the manufacturing work of the Government should be organized upon business principles, that the various departments should specify what they want, and how it is to perform the service expected of it; that it should then depend upon the Department of Manufactures to produce the things desired, and that the man to be at the head of such a department should be one skilled and experienced in carrying on manufacturing operations; that he should be also a member of the Cabinet, with the title of Secretary of Manufactures, though, of course, the functions of carrying on manufacturing operations might properly be given to the Secretary of Commerce and Labor.

The United States Government not only carries on manufacturing operations upon an extensive scale, but it contracts with private manufacturing concerns for amounts reaching many hundreds of thousands of dollars annually. Most of this work is conducted by men who, whatever their natural and acquired abilities may be, certainly have not had anything like the training and experience that in private life would be considered essential to success and which really are essential. It is because there is no co-ordinated organization and no one at the head who understands how to carry on manufacturing operations that so many queer things happen in connection with the inspection of naval vessels being built in private shipyards.

Most of the military officers who have been placed in charge of our various arsenals have acquitted themselves very creditably, considering the circumstances, but the circumstances have been wrong and they will not be right until a manu-

facturer is put in charge of manufacturing operations carried on by or for the Government.

The "Bennington" Disaster.

Since writing as we did last week of the "Bennington" disaster, it transpires that Secretary Bonaparte has refused to accept the findings of the court of inquiry and has ordered that the commander of the "Bennington" shall also be tried by court martial. We venture to predict that it will be found that the commander of the vessel is very little, if at all, to blame for the disaster. It is the system. It has been repeatedly prophesied by men competent to judge that the abolition of the engineer corps and the manner in which the personnel bill has been working, would insure, sooner or later, a disaster such as occurred on board the "Bennington." It is about as certain as anything can be, that there must be a competent engineer corps to take charge of steam-engineering matters connected with the navy, and that the men composing this corps must have control of affairs within that department, which control must be fully commensurate with their responsibility. There can be no half-way stopping point in this matter if smooth working and efficiency are to be attained.

Say what we will, the fact remains that the condition of affairs revealed by the "Bennington" disaster would have been simply impossible if a competent engineer had been in charge of that department of the vessel, and if that engineer had had the authority he ought to have; an authority fully covering those things for which he is supposed to be responsible and must be held responsible before things can be on anything like a satisfactory basis in the United States navy.

Standard Specifications.

The American Society for Testing Materials has sent to the membership, with a mail ballot on the adoption thereof, a series of proposed standard specifications for various materials, which include steel forgings, steel axles, gray-iron castings, steel castings, structural steel for bridges and gray-iron car wheels. The specifications are published from the office of the secretary-treasurer, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

Determining the Position of Idler Pulleys for the General Case of Belt Transmission—Erratum.

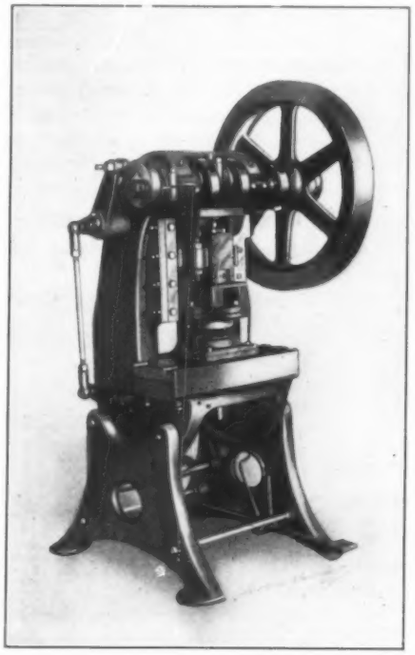
In the title of the above named article, at page 260, read *case* for *care*.

A large steel floating dock was recently launched at the Mitsu Bishi Dockyards, in Japan. It is 387½ feet long by 85 feet wide by 41 feet 7 inches deep.—*The Engineer.*

New Tools and Machine Shop Appliances.

DOUBLE-ACTION PRESS.

The accompanying illustration shows a double-action cam draw press which can be set in inclined position so that the finished work discharged from the die can drop through the opening in the back of the press. The inclining device consists of a vertical screw and hand wheel. The change from one position to the other is quickly made, without danger of having the press tip too far, as the adjusting screw will hold the frame positively in all positions. The cams, cam rollers and pins for the blank-holder slide are hardened and ground. Grease cups are applied to the cam-roller pins also at the end of the crankshaft near the balance wheel, to insure continuous lubrication. A positive clutch of the sliding-pin type controls the

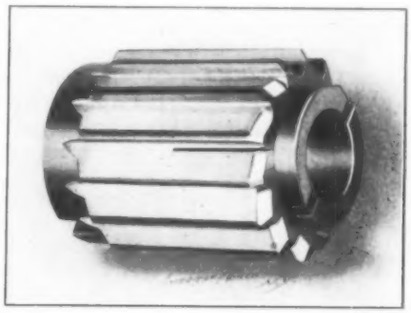


DOUBLE-ACTION PRESS.

motion. Of each revolution, one-sixth is allowed for cutting, one-third for drawing, and during the remaining half of the revolution, the blank holder and inner slide will rise to the upper position. A separate cam mounted outside of the frame of the press is used to raise the blank-holder slide. In some cases, where the finished work is to be ejected upward, a bottom knock-off attachment, as shown in the illustration, is applied. It consists of a rock shaft under the bed, operated by a lever outside of the frame. This arrangement leaves the opening in the back of the press unobstructed. The particular press shown will draw work of light stock up to 6 inches diameter and 1¾ inches deep. The distance from the center of the slide to the back is 6 inches; and from the bed to the plunger, with stroke down and adjustment up, 10 inches. The distance to the outer slide is 7½ inches, and the width of the opening of the bed, 14½ inches. The press weighs about 3,100 pounds, and is one of a line recently brought out by the Niagara Machine & Tool Works, Buffalo, N. Y.

EXPANDING SHELL-CORE DRILL AND REAMER.

The half-tone shows an expanding shell drill for use in cored holes, and which, in the 3-inch size from which the photograph was made, will remove ¼ inch of metal on a side. The shell has a standard hole at the inner end to receive a standard shell-reamer arbor, the outer end of the arbor being turned straight to pass through the expanding sleeve. As made in the reamer form, with solid shanks for use in the chucking machine, the tool has



EXPANDING SHELL-CORE DRILL.

a taper expanding plug in place of the sleeve. The maker is the Three Rivers Tool Company, Three Rivers, Mich.

DIAL TEST INDICATOR.

Fig. 1 gives a general view of this new appliance, Fig 2 a sectional view showing its construction, Fig. 3 some uses to which it may be put. Referring to the section in Fig. 2 it will be seen that the stem,

FIG. 1. DIAL TEST INDICATOR.

or push pin, *a*, which comes in contact with the work to be tested, carries at its inner end a wire *b*, which lies in a slot cut crosswise of the boss through which the push-pin passes. The end of the wire or crosspin enters a spiral groove in barrel *c*, and when the push-pin is operated the barrel, through the gearing shown, actuates the indicator point *d*. A spring *e* resting on pin *b* normally retains the push-pin in its lowest position, as indi-

cated, and a hair-spring at *f* takes up all backlash. The dial is graduated to read to half-thousands, either way from zero (or where preferred may be made to read one way only), and the case is so

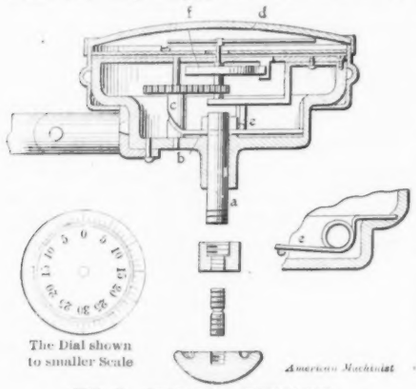


FIG. 2. DIAL TEST INDICATOR.

made that the upper half carrying the dial may be turned with the fingers so that in starting to test a piece the zero line may be brought under the pointer and variations either way read directly from the dial. The stem *a* has a stop collar to limit its movement, and the contact button is attached to the stem by a screw provided with a weakening groove to permit the button to break off without injury to the stem should it be accidentally struck. The arm for holding the indicator is attached by a joint which allows

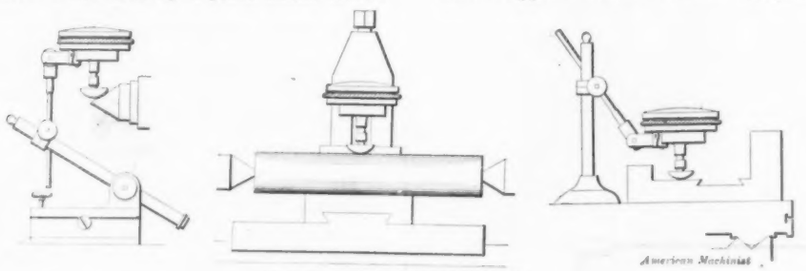


FIG. 3. DIAL TEST INDICATOR.

the tool to be easily adjusted to any position required. This tool is made by the W. R. Reisner Manufacturing Company, Hagerstown, Md.

Experiences of the Repair Man.

One of our repair men offers the following from among his personal experiences: "I was sent out one day to a plant on complaint of the engineer that a steam trap, bought from the company, was not working. The engineer complained that the trap was blowing all the time, and thus wasting steam. I found that he had connected the discharge where the by-pass should be, and had screwed the centerpiece of the by-pass in the discharge opening. On another occasion I was sent to a large office building, on complaint of the engineer, that a 3-inch medium wedge valve, used as a throttle valve on one of their large hydraulic pumps in the elevator service, leaked. The pump was in operation at the time I was there, and no examination could be made of the valve. The engineer's word was taken that the valve leaked so badly that the pump could not be packed. I was sent there the following Sunday to put in a new valve, which I had specially tested for the job. It was only a short time until the same complaint came in again. This time I made a thorough examination of all piping connected with the pump. A ¾-inch drain pipe, leading to a steam trap from a separator between the pump and the throttle-valve, was traced to the subbasement, where it was cross-connected with a drain pipe from a steam header. This is where the supposed leak came from. A check valve was put in the ¾-inch line, and all further trouble stopped. These mistakes happen very seldom. Most of the troubles on wedge valves are traced directly to dirt, pipe scale, or some foreign substance becoming firmly fixed between the disks and body rings, and thus injuring the brasses. Some time ago a valve was returned as defective. The bonnet was removed for examination, and a penny was found so firmly driven between the body rings by the closing of the disk that it was bent to an angle of nearly 90 degrees."—*The Valve World.*

Eighteen Liners for Japan.

A Glasgow press despatch dated August 31 says:

"The Nippon Yusen Kaisha (Japan Steamship Company), through the Japanese consul, is placing contracts for eighteen liners with Clyde shipbuilding firms."

Manufacturing Cannon for the Japanese.

The Seattle branch of Crane Company recently turned out two cannon, throwing 5-inch shells, for the Japanese.

The armament was not, however, used against their enemies, the Russians, but as a salute to Baron Komura, who recently arrived at Seattle via the steamer *Minnesota*, en route to the Peace Commission at Washington, D. C.

The cannon were made out of 5-inch extra strong pipe with cast-iron caps on one end, and threw a 5-inch compressed paper ball containing a silken Japanese flag, on two corners of which were attached weights, so that when the ball exploded in mid-air the flag opened out and made a very pretty sight as it floated earthward.

While the cannon were somewhat crude in comparison with modern artillery, the shells were a fine example of Japanese skill and ingenuity.

Making the Pattern and Mold for the Side of a Power Screw Press.

BY R. H. PALMER.

The pattern I wish to describe is one from which two castings were made for a large power screw press, the castings forming the sides of the press, the whole press weighing 26 tons.

Fig. 1 gives a plan of the casting.

Fig. 2 gives a side view of the casting.

These views will also represent the pattern when all its parts are assembled.

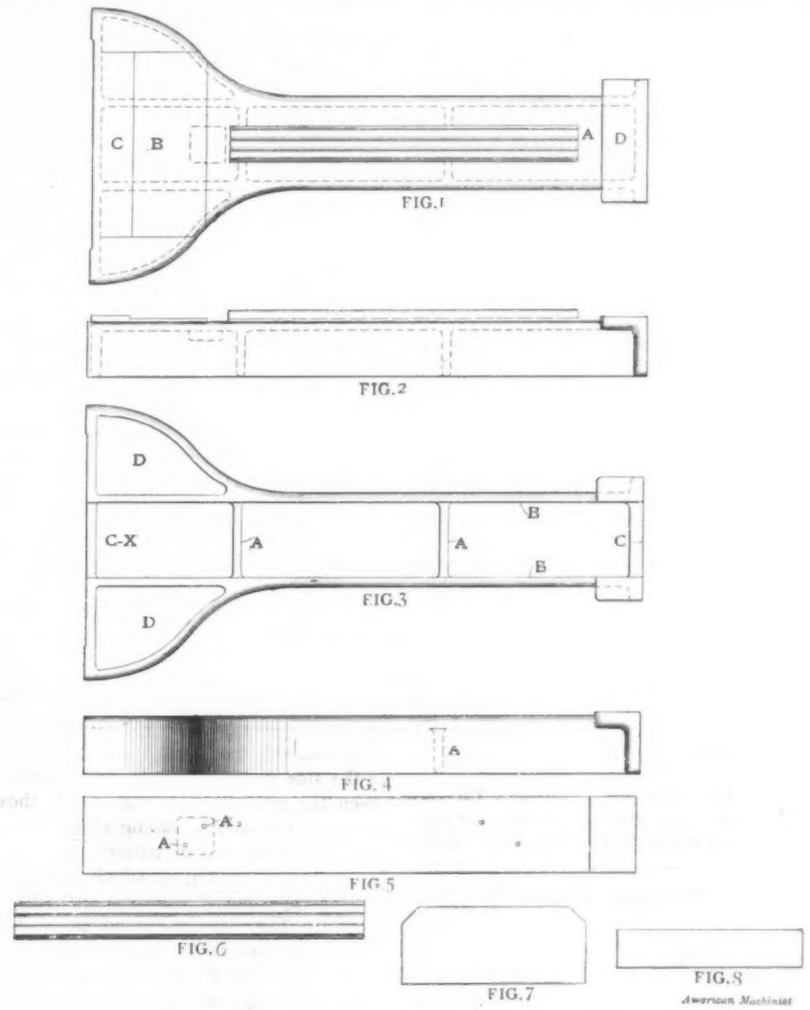
As the pattern is to be bedded in the floor and only a cope used, it is made somewhat differently from what it would be were a drag to be used and be rolled over after being rammed up. In the case where the pattern is laid on a moldboard, with top side down, the parts above the top surface, as Fig. 1, *A*, *B* and *C*, being loose, would be left off; and the planing piece *D* would be loose, or could be cut into board, as when the molder commenced to make his mold he would do so, beginning from the inside surface of the pattern. The pattern would be surrounded by the drag; after being rammed up and bottom board placed, the whole would be rolled over. But in this case, as the pattern is bedded in the floor with the top, Fig. 1, up, and this side coped off, provision must be made to allow the molder to secure his mold as he builds the foundation, then places pattern, which he rams the sand around, and inside, thus making the top face of the inside of pattern last in what takes the place of drag; namely, the floor of the foundry. In making the pattern, the part, Fig. 3, is first made, Fig. 3 being the plan and Fig. 4 the side view of the pattern. It will be seen the cross ribs *A*, Fig. 3, are shown at *A*, Fig. 4, as not coming all the way to th top. The top of pattern, or of Fig. 3, is formed by Fig. 5, which is made to fit loosely (not too loose) between the sides *B*, Fig. 3, and rest on ends *c*, also on cross pieces *A*. Pieces Figs. 6, 7 and 8, shown in Fig. 1, as *A*, *B* and *C* are the loose parts of pattern to be taken up in cope; they are pinned on top of Fig. 3, thus giving top view of pattern as Fig. 1 as a whole. As we make the mold, the reader can see why the parts are left loose instead of being fastened together as for rolling over.

The hole is dug and plates *A A*, Fig. 10, are placed and rods are hooked into them, and the hole or pit rammed up the required height; then cinder bed *C* is placed, extending through the center, also wide enough to extend under side pockets of pattern, *D*, Fig. 3. The cinders are covered with paper, and pipes placed connecting with cinder bed to carry the gases,

or vent, as molders say, to the top of floor, as *D*, Fig. 10. Sand is then rammed over the paper to within a short distance of where the bottom line *E*, Fig. 10, will come.

Part of pattern, Fig. 3, is now set in the hole, or pit, and is wedged up level, and some pieces of pig iron placed on it to keep it in place. Facing sand, made by mixing molding sand and seacoal facing together, is then used and is tucked under the lower edge and laid against the sides, and the outside and inside are ramm d up (wedges being removed at proper time) on the outside of pattern because the pockets *D* are to be covered with a dry sand core. Strikes are now used, and the center is struck out between ribs *A*, Fig. 3, *J*, Fig. 10, to 1 inch below the top of them, and the ends of pattern *C*, Fig. 3, *K*, Fig. 10, and the whole inside of pattern part of mold is given a good venting down to the cinder bed.

It is pretty well known that a molder can round a corner in a mold by shaving with his trowel. As one molder used to say to his employer, "Here goes for profit, Bill," and he would shave a good big corner off to add weight to a casting.



MAKING THE PATTERN AND MOLD FOR THE SIDE OF A POWER SCREW PRESS.

to as high as where joint is to be made, while on the inside the sand is brought through the center as high as the top of crosspiece *A*, Fig. 3. At proper stages of the ramming up of the outside of pattern, the pouring gate *F*, Fig. 10, is placed; also sprue *G*. While on the inside of pattern, when about half way up, iron rods *H*, Fig. 10, are driven down to secure the center between the sides marked *B* in Fig. 3, shown in Fig. 10 at *I*, and the cross ribs *A*, Fig. 3, or *J*, Fig. 10. In the side pockets *D*, Fig. 3, of pattern, they do not come up as high as in the center As weight in this casting is not wanted, the molder is given a strip to bed in on each side between ends and crossribs *A*; then at the proper time, when finishing the mold, it is a simple matter to just round the edge a little. Facing sand is again used, being placed and pressed down by hand, and the V piece bedded in as wished. The space between the end, Fig. 3, *C X*, and first crossrib *A* is not finished at the end near *A*, but is measured off and a space dug out where part *A* of pattern Fig. 5 is to come; see *L*, Fig. 10. Some facing sand is put in the bottom and left lying loosely. The part of pattern Fig. 5 is now placed between the sides *B* of part of pattern Fig. 3, and rapped down, then taken up to see that part *L*, Fig. 10, has a proper bearing on the bottom; finding it has, the part, Fig. 5, is replaced, and the joint is made around the outside of pattern, though vents are first run down around the pattern to the cinder bed.

The side pockets are rammed full of sand to the top of pattern; as there is no wooden part of pattern over them, when they are rammed full of sand, and the parting made, they serve as the pattern on which the cope is to be rammed up.

MAKING THE COPE.

The loose parts Figs. 6, 7 and 8 are now placed. The cope is placed, rapped down and staked in the corners *M*, Fig. 9. In making the first one the cope was barred to fit the pattern after it was bedded in; in making the second, care was taken when the pattern was rammed up in the floor that it was placed so that the cope would fit it.

In bedding work in the floor where large, heavy copes are used, it is customary to place on a number of the bottom binders, spuds or pieces of timber to extend as high as the joint, so when the cope is being bolted or weighted down ready for pouring its pressure on them does away with the danger of the cope settling down, as the nuts are tightened down on the bolts, and crushing in the sides of the mold.

In this case the cope used was much too large, but shallow. For that reason a timber *A*, Fig. 9, was run across the top of the flask to strengthen the cope and chucks nailed on to it extending down between the bars as *B*, Fig. 9.

The cope is now rammed up with pouring gates, and risers for pumping, set; the whole being well vented. The mold is parted, the loose pieces being lifted in the cope, which is turned on the side and the pieces drawn out and finished. In finishing the round on the face of the cope, formed by the corner being taken off when slide shown as Fig. 6 joins the top of pattern, it is well nailed to prevent "drawing down," as molders term it, while the mold is filling with iron.

The cope being finished the part of pattern Fig. 5 has screws *A* drawn out, and is removed, thus leaving part of pattern *J*, Fig. 10, in the sand; the part of mold around it is then made up, and nailed and vented, and *J* drawn out. Part of pattern Fig. 3 then has pockets *D* swept down to the required depth below the top of pattern, and well vented down to cinder bed. Fig. 3 is then drawn out, gates *F*, Fig. 10, are drawn in, and sprues *G* drawn, and gate cut connecting them with sprues *C* and *D*, Fig. 9, in the cope. The corners of pockets are wiped off by hand as referred to, and cake cores of dry sand are placed on top of pockets *D* and the sand

tucked under, around them, and rods driven down through holes in them so that there will be no side slipping. Corners of pockets are well nailed, needle-wired, and the mold finished and blacked. Balls or cones of clay are placed on the pocket cores, where it is desired to have the chaplets to hold them down to bear, and the points are tipped with flour. The cope is tried on, and hoisted off; chaplets are pushed up through the cope where the flour-tipped points of clay mark their places, and the cope is replaced. Binders *E*, Fig. 9, are placed across the cope, resting on blocks *F*, which are high enough to carry binders about one-half or three-quarters of an inch above timbers or backbone *A* of the flask. Bolts *N*, Fig. 10, are hooked in to the lower bolts *O* and nuts *P* tightened down; wedges *R* are then placed and pushed in, thus causing the binders to receive the whole of the upward strain of the cope. Binders *H*, Fig. 9, are placed to hold the chaplets that are not caught by binder *E*. These hold cake cores on top of pockets down, and wedges are used to hold the chaplets *I*. Runner *N*, Fig. 9, should be built, also flow-off *O*, Fig. 9, and risers *P* be built up for churning.

A word for the pouring: Arrange the gates of a mold so the iron may fill the mold quickly, and there is less danger of drawing down.

The part of pattern shown in Fig. 3 has strips of flat iron screwed on the sides with a toe turned under the pattern, and extending above the pattern where there are ¾-inch holes drilled through them, thus providing a way for the molder to hook into them, and not be obliged to use wood screws to the detriment of the pattern.

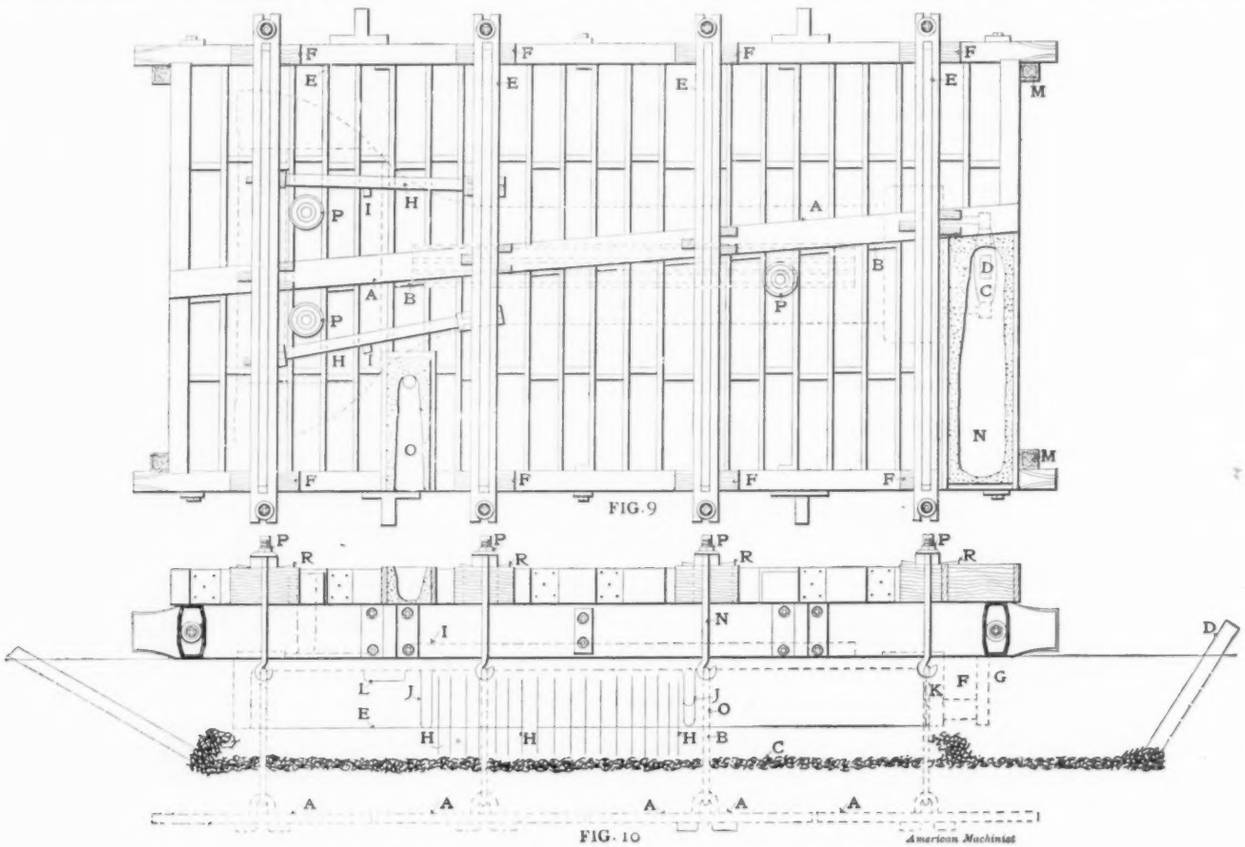


FIG. 9

FIG. 10

MAKING THE PATTERN AND MOLD FOR THE SIDE OF A POWER SCREW PRESS.

Files and the Scrap Heap—Tools From Old Files.

At page 771, Vol. 28, Part I, we published a letter with reference to utilizing old files. The following extract from the *Cycle Trader* has a bearing on this matter and may contain a lesson for some shop foreman or storekeeper:

Some shop managers insist on a great deal of odd material being saved which may, some day or other, be found useful, but which seldom is. Others allow the men to put on the scrap heap materials which may be found most useful in the shop, and sometimes almost indispensable. In such shops as the latter the proprietor is assuredly losing money every day.

Take a case in point: I remember a shop where a great many frames were built and where constantly a great deal of filing up was done. The filing up was done at piece-work rates, and it was, of course, natural that the men on this particular job would try to get through as many frames in a day as possible. Naturally, also, they would get as many new files as they could, and equally naturally the manager would see that all files were worn out before being replaced with new ones.

Each man when started was given a full set of files, and when he required a new one the old one, either worn out or broken, had to be delivered into the stores before the new files were sent out. The storekeeper, after seeing that the files returned were really unfit for use, issued new ones and threw the old ones on the scrap heap.

Now, the scrap heap was the common rubbish heap of the shop, to which all had access. What was more natural than that, when a man wanted a new file so as to cut quicker and get through more work, even if his old file was not nearly used out, he should go to the scrap heap, select the oldest file of the class he wanted, throw away his half-used file and stalk up to the stores with the old file, which had probably done the same duty hundreds of times before, and return with a new file. And so things went on. The storekeeper only gave new files out against absolutely worthless ones, which he threw on the scrap heap; the men always had new files when they wanted them, and every one was contented. The scrap heap collected quite a little stock of half-used files, the men made good piece-work wages, and the proprietor paid for about twice as many files per week as were needed.

I remember that, at the time, the shop manager was greatly elated over the very

simple little system which prevented the giving out of files to men who had not used their own out. When one corner of the scrap heap was disclosed to him he discovered that his system was just the very system which allowed the men to do exactly what he was trying to prevent.

Now, the scrap heap may in similar cases contain materials which ought not to be there, and the only way to avoid such fraud on the storekeeper is for him to break up all files into at least three pieces before throwing them away. Very seldom is a file accidentally broken into more than two pieces, and the stores man should insist on having old files returned intact before new files are given out.

At the same time, old files, especially flat and round files, are very handy to be kept in the stores as raw material. Very good screwdrivers can be made from old flat files, and old round files make good center punches and even flat drills. In many shops the small-size dies for screwing are made from flat files, and these are generally found to be exceedingly lasting for such purposes if properly made in the first instance.

Perpetual Motion by Flotation Again.

A correspondent has sent us a clipping from a country newspaper describing a perpetual motion machine of the type which works (or, rather, is going to work when it is completed) on the cork-buoyancy principle. The following is the description:

"The device is a wheel having hollow spokes. It is set to turn on an axle, when completely immersed in liquid. A common cork is fitted into each tube spoke. These corks have each a weight attached and are so adjusted in the tubes as to move easily from the outer to the inner end of the tube spokes. The buoyancy of the liquid tends constantly to drive the cork and weight attached upward as the wheel turns. Hence the cork in the spoke that is perpendicular above the axle will be at the upper end of the tube spoke or at the furtherest point from the axle, while the one in the tube spoke that is perpendicular downward from the axle being also driven upward by the liquid is forced to the end of the tube spoke nearest the center of the wheel. Therefore, as the spoke extending upward moves over the center the law of gravity being by means of a lever principle embodied in the wheel and axle device given the advantage over the buoyant force of the liquid pulls that part of the wheel downward as soon as the given tube spoke passes the half-way point between the extreme upper and lower point, the buoyancy of the liquid overcomes the force of gravity and tends to drive the cork again to the center of the wheel, thus the excess force of gravity thus alternating with the excess force of buoyancy of the liquid causes the wheel to keep going forever after it is once started or made to begin revolving."

Most intelligent people will of course know that the inventor will be disappointed, because in accordance with the law of the Conservation of Energy no machine to which energy is not supplied can create or give out energy, machines simply serving to convert energy of one form into that of another; yet we believe many would be at first puzzled to detect the fallacy in this case.

The inventor's argument is apparently that the weights attached to the corks on, say, the left side of the wheel, being further out from the center than those on the right side, and the force of gravity therefore acting with a greater leverage on the left side weights will cause the left side of the wheel to descend. He appears to have overlooked the fact that the "buoyancy" of the corks, which acts in the opposite direction to the force of gravity, is also acting with a greater leverage on the left-hand side, and hence its tendency is to cause the left side to ascend. As the upward tendency of the corks must be greater than the downward tendency of the weights in order that the corks may float up in the tubes, carrying the weights with them, if the wheel tended at the start to turn at all, it would be in the direction opposite to that in which the weights act. But it would come to rest with the corks in the upper tubes at or near the outer ends, and the lower corks up near the center of the wheel, the arrangement on one side corresponding to that on the other and the result being equilibrium.

Inventions and Designs in India.

The annual report of the Patent Office for 1904 suggests many reflections, not all of them exactly pleasant. The number of applications to file specifications was but 552 for the year, an advance of 16 only on the previous year.

This is not very grand for a population of 300,000,000, not wanting in ingenuity, and progress seems very slow. What slight increase has been recorded in the past decade is chiefly due to foreign applications, those of native origin being apparently stagnant at the low figure of 45 to 50 per annum.

The leading place is occupied by inventions relating to transport, which marks the special need of the country. Next come textile and electric contrivances, while tea makes a bad third.

Rather more forethought or caution appears to have been exercised of late years in the filing of specifications, since the number of patents lapsed at the end of the fifth year tends to diminish. It used to be over a half, it is now less.

But with so few to deal with it is unwise to draw inferences. That there should be so few is to be lamented. It is a sign of the undeveloped state of all industry in India.

Industry develops by division of labor. It is division and sub-division of labor that makes possible the avalanche of specifications that every year descend upon the patent offices in Europe and America. While one man does several different things his place cannot well be taken by any mechanical device, but if the same thing is done by several men one machine will perhaps replace the lot.

In a healthy state of development the operations of an industry are continually being split up. Every operator comes to confine himself to fewer acts and motions, and performs them more and more mechanically until they become at last so simple that they may be done with greater accuracy and quickness by the help of some mechanical device.

Here lies the chance of the inventor. The operator himself is often the first to perceive it, and in the United States of America workingmen take the lead in the number of inventions made. In India it is the opportunity that is lacking, of ingenuity there is plenty; but primitive industry, contrary to common ideas, affords but little scope for it.—*Indian Engineering.*

Chemical Engineering at the University of Wisconsin.

The repeated calls for graduates trained in chemical engineering has led the University of Wisconsin, Madison, Wis., to organize a course of instruction in that line of work. Provision is also made for specializing in gas engineering should the student desire. The new course will be ready for students the coming fall. A special circular has been issued from which further particulars may be obtained.

Personal.

B. H. Warren retired, on August 31, from the presidency of the Allis-Chalmers Company, of Milwaukee. It is said that he will become the head of a new engineering and contracting company in New York.

The National Twist Drill & Tool Company at its last annual meeting elected as a director J. O. Whitaker, president of the Whitaker Manufacturing Company, of Chicago. Mr. Whitaker has had wide experience in the manufacture and sale of twist drills, reamers and kindred lines, having had charge of the sales department of the Whitman & Barnes Manufacturing Company for many years.

W. H. Squire, Cornell '97, formerly with the American Tool Works Company, of Cincinnati, and the McConway & Torley Company, of Pittsburg, who has been traveling and studying in Europe since 1901, has been appointed assistant to the "Administrateur-Directeur" of the Société Anonyme Hotchkiss, builders of the universally known "Hotchkiss' cannon and automobile. Mr. Squire is at the general offices, 21 rue Royale, Paris.

J. W. Frazier, J. H. Fox and J. C. Spencer have formed a partnership under the name of Frazier, Fox & Spencer, and opened offices as consulting engineers in the Rockefeller Building, Cleveland, Ohio. Messrs. Frazier and Fox have been connected for about six years with the designing and contracting departments of the Brown Hoisting Machinery Company, of Cleveland. Mr. Spencer for several years was in the engineering department of the American Bridge Company and for the past year has been practising in Cleveland as a consulting architectural engineer.

Obituary.

Patrick Delaney, an expert designer and builder of boilers, and head of the Delaney Boiler Works, of Newburg, N. Y., died August 28. He was born in Ireland in 1842.

Manufacturers.

The Syracuse (N. Y.) Safe Company will erect a new factory.

J. J. and M. Conally are erecting a boiler factory at Gadsden, Ala.

A $50,000 machine shop will be erected at Kingston, Pa., by the Adder Machine Company.

A large tin-manufacturing plant is to locate in Niles, O. Wm. Herbert, of Niles, is interested.

The General Electric Company will erect a large new foundry at its work in Schenectady, N. Y.

The Clarke & Baker Company, Ilion, N. Y., will expend $100,000 to erect a file and cabinet factory.

Additions will be erected in the near future to the Norfolk & Western Railroad shops in Roanoke, Va.

The Atlantic Coast Line will erect shops to cost in the neighborhood of $500,000 at Waycross, Ga.

The John Simmons Pipe Bending Works, Newark, N. J., were destroyed by fire, at a loss of $100,000.

A new plant will be erected in the near future in Youngstown, O., by the Republic Iron & Steel Company.

The Clarke & Baker Company, Ilion, N. Y., will expend $100,000 to erect a file and cabinet factory in that city.

The National Corundum Wheel Company is building a new factory at Main street and the Erie tracks in Buffalo, N. Y.

The United Railways, Westport, Mass., will erect a power-house on their property. Architects, Simon & Pietsch.

J. W. Hambrick and others will erect a $100,000 plant for the manufacture of automobiles at Huntington, W. Va.

The Minneapolis (Minn.) Steel & Machinery Company will enlarge its plant by the erection of several brick buildings.

E. E. Pierson, Kansas City, Mo., is interested in a scheme to erect the largest warehouse in the world at Kansas City.

Cincinnati, O., will expend $1,000,000 in improving its water-works. Garry Herrmann is president of the Water-Works Commission.

The Aden Lumber Company, Vallejo, Cal., has under consideration the installation of an electric motor, to cost from $700 to $1,200.

Ground has been broken on the Ayer property, Lowell, Mass., for the new shop which is to be erected by the Shaw Machinery Company.

The Axtell-McKee Manufacturing Company, Fort Worth, Tex., has been incorporated, with a capital of $100,000, to manufacture windmills.

Fire in the three-story brick carriage factory owned by H. H. Hart, 55 to 61 Albany avenue, Hartford, Conn., damaged the plant $15,000.

The plant of the Canada Machinery Company, at Point Edward, Ont., was burned recently. Estimated loss, $125,000; insurance, $60,000.

A permit has been issued to J. W. Kline for the erection of a two-story brass foundry building, to be located at 426 North Second street, Reading, Pa.

The Worcester (Mass.) Machine Screw Company will enlarge the capacity of its plant by the addition of twenty-five automatic screw machines.

George A. Glenn & Co. have a contract for alterations, costing $10,000, to the plant of the American Nickel Company, at Tenth and Elm streets, Camden, N. J.

A plant for the manufacture of steam turbines will be erected at Huntington, W. Va., by the Jarvis Machinery & Supply Company. Joseph C. Jarvis is interested.

The Burtt Manufacturing Company, Kalamazoo, Mich., will erect a new factory building. President Burtt announces that operations will begin in a few weeks.

A new one-story brick factory building will be erected, corner of Kent and Trowbridge streets, Chicago, Ill., at a cost of $6,600, by the Grand Rapids Foundry Company.

The Opelika (Ala.) Electric Light Company intends to increase the capacity of its plant threefold in order to provide power for a local electrical railway about to be built.

It is stated that the Alabama Steel & Wire Company, Ensley, Ala., will improve and re-equip its plant at a cost of several hundred thousand dollars. E. T. Schuler, president.

The Pennsylvania Railroad has just awarded a contract for the enlargement of the big shops at Harrisburg, Pa. At these shops a great deal of car-repairing work is carried on.

The National Enameling & Stamping Company, Light street and Ohio avenue, Baltimore, Md., is contemplating the enlargement of its plant. George W. Knapp, director-general.

James C. Smith has secured the contract for the construction of a building to be erected at 315 North street, Baltimore, Md., for Edro Richardson, to be used as a brass foundry.

The Public Service Corporation, Elizabeth, N. J., is to establish a repair shop and construction yards, fully equipped with machinery and other appliances for wood and metal working.

The Trimont Manufacturing Company, of Roxbury, Mass., will locate in New London, Conn. New buildings will be erected, and the business of the company will be greatly enlarged.

Appleton & Burrell have secured the contract for the erection of a foundry building for the Bernstein Manufacturing Company, at Third and Westmoreland streets, Philadelphia, Pa.

The Gordon Manufacturing & Power Company, North Wilkesboro, N. C., incorporated with a capital of $21,000 to operate a plant for generating electric railways, by J. Gordon Hackett *et al.*

The National Enameling & Stamping Company is to build at once on its property adjoining its present works at Laurel Hill, Md., a new four-story brick factory building, to cost over $150,000.

The Parkhurst Boiler Company's plant, Oswego, N. Y., which has been idle for the past year and a half, owing to a failure of the concern that backed it, will be opened up in a few weeks.

A new $100,000 stock company has been organized in Bucyrus, Ohio, to establish a plant for the manufacture of steel castings. The company will put up a modern plant of 40 tons daily capacity.

The Pressed Steel Pole Company, of Pittsburg, Pa., is seeking a location, through its attorneys, Steuart & Steuart, of 213 St. Paul street, for the establishment of a steel-pole plant in Baltimore, Md.

The new building of the Union Twist Drill Company, Athol, Mass., will be of brick, 180x60 feet, and will be erected by Foss, Briggs & Chamberlain, of Worcester, Mass. The work will begin at once.

The National Cutlery Association has taken title to a large plot of ground at the southeast corner of Boudinot and Westmoreland streets, Philadelphia, Pa., on which a large factory is to be erected.

The Fairbanks Gasoline & Motor Manufacturing Company, of Chicago, has commenced to build a factory on Bloor street, Toronto, in which 1,000 men will be employed. The building will cover eight acres.

The United Drop Forging Company, West Springfield, Mass., recently organized, will at once begin the erection of a building, 100x60 feet, one story, wood. E. W. Shattuck, of Springfield, is the contractor.

H. K. Stroud is president of the Stroud-Humphrey Manufacturing Company, which has been incorporated for the manufacture of gasoline engines, etc. A new plant will be constructed at Hastings, Minn.

The Posey Automatic Switching Company, Fort Worth, Tex., expects to erect a factory in the near future for the manufacture of a device for the automatic turning of switches for street car lines, etc.

The city of Carthage, Mo., will in a short time purchase two 60-cycle, two-phase, 2,200-volt, belted-type alternators; also condensing outfit for the present steam plant equipment. A. P. Knowles is superintendent.

The N. P. Pratt Laboratory (Atlanta Ga.), engineering department, is erecting foundry and machine shops, and is interested in figures on machine tools and kindred appliances. George L. Pratt is engineering director.

The United States Cast Iron Pipe & Foundry Company, the Bessemer Foundry & Machine Company, the Bessemer Soil Pipe Company and the Central Foundry Company, all of Bessemer, Ala., are adding largely to their capacity.

The Adams & Elting Paint & Varnish Company, Chicago, Ill., has purchased property on the Terminal Transfer line on Taylor street, near Forty-fifth avenue, and will in the near future erect a large factory on the site purchased.

It is stated that the Alabama Great Southery Railway has taken possession of the shops of the Southern Car & Foundry Company, Birmingham, Ala., and intends operating this car plant to its full capacity. W. A. Garrett is general manager.

The Baltimore Foundry Company, Baltimore, Md., incorporated to manufacture metal castings, etc., has purchased the old Lorraine foundry plant at Bush and Wicomico streets, and will make additional improvements to the building. Andrew J. Dietrich is president.

It is announced from Lynchburg, Va., that the Virginia Iron, Coal & Coke Company contemplates enlarging its present furnace at Radford, Va., so that it will have a daily capacity of 200 tons instead of 150. The company, it is stated, will also build a 200-ton furnace at the same place.

New Catalogs.

Crocker-Wheeler Company, Ampere, N. J. Bulletin No. 60, superseding Bulletin No. 42, "Small Motors."

Crane Company, Chicago. Advance Circular No. 4-SDV, descriptive of renewable spring disc brass valves.

The Fred J. Swaine Company, St. Louis, Mo. Catalogue descriptive of presses and dies of various types. 6x9, pp. 32. Illustrated.

Union Twist Drill Company, Athol, Mass. Catalogue "B," with price-list, devoted to the various cutters manufactured by this company.

Sprague Electric Company, New York. Bulletin No. 223, descriptive of type "N" motors, specially designed for crane service. Pp. 11. Illustrated.

Charles Bond, Philadelphia, Pa. Catalogue No. 5, descriptive, and price list of power-transmitting machinery and supplies. 6x4, pp. 92. Illustrated.

The Barriett Electric Manufacturing Company, Cincinnati, O. Bulletin No. 4, descriptive of the electric motors and dynamos manufactured by this company.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1108, descriptive of Westinghouse regulating and reversing controllers. Illustrated.

Shartle Bros. Machine Company, Middletown, O. A wall-hanger containing descriptive matter of the flybars, bedplates and engine fittings made by this company.

Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. Circular No. 1,086, devoted to motor controllers for power, mining and railway service. Illustrated.

The R. K. Le Blond Machine Tool Company, Cincinnati, O. Two catalogues descriptive of milling machines and lathes. Handsomely printed and illustrated. 6x9, 90 and 30 pp.

Machinists' Supply Company, 14 South Canal street, Chicago. Catalogue and price-list of the many machinists' supplies furnished by this company. 6x9, pp. 625. Illustrated.

Baldwin Locomotive Works, Philadelphia, Pa. Catalogue issues Nos. 51 and 52. Two handsomely printed and illustrated books, "Records of Recent Construction" of this company.

The Goulds Manufacturing Company, Seneca Falls, N. Y. Catalogue descriptive of the new Goulds works and of the many types of power pumps manufactured there. 6x8, pp. 192. Illustrated.

Lagonda Manufacturing Company, Springfield, O. Catalogue A and two supplementary circulars, descriptive of the Winland boiler tube cleaners and boiler-room and steam specialties. 6x9, pp. 24. Illustrated.

The Willamette Iron & Steel Works, Portland, Ore., sends us several handsomely printed hangers illustrating a 36-inch gang sawmill, a compound direct-connected electric lighting system and the drum system of the Willamette Crack-a-Jack.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago.

Special machinery to order. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

I design factories and special machines. James F. Hobart, 66 70th st., Brooklyn, N. Y.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Brown & Sharpe screw machine cams, designed by experts, will greatly increase production. Send sample or sketch for estimate. Box 761, Waterbury, Conn.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments, meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Manufacturers' Agents.—We are prepared and desire to represent manufacturers of devices new in this territory. G. S. Carter Machinery Co., 225 North First st., Minneapolis, Minn.

Incorporation of mechanical industries, and other legal matters relating thereto, specialized. Correspondence solicited. Send for references. Fred'k P. Schenck, N. Y. and N. J. Counselor, 141 Broadway, New York.

Engineer's License.—Engineers, electricians, firemen and machinists, send for 52-page pamphlet describing "Spangenberg's Steam and Electrical Engineering," just out; best book ever published; sent free. Geo. A. Zeller Book Co., 20 S. 4th st., St. Louis, Mo.

Wanted at Once—A second-hand steam shovel, in good repair, to handle clay free from hard shale, with a capacity of not less than 250 yards in ten hours. Thew shovel preferred. Give complete description, with length of service, with price delivered and set up in our clay pit. Address Calhoun Brick Co., Calhoun, Ga.

For Sale.

New Tabor indicator for sale; cheap. Address "Tabor," 323 W. 124th st., New York.

For Sale—Small, well-equipped machine shop, near New York; cheap power. Box 513, AMERICAN MACHINIST.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

The complete course in civil engineering, including about 12 bound volumes, as given by the International Correspondence Schools of Scranton, Pa. "Education," care AM. MACH.

Business Opportunities.

Opening for Manufacturer.—The proprietor of a long-established foundry and machine shop in a small Ontario town invites correspondence from any reliable American manufacturer in the machinery line wishing to establish a plant in Canada. The plant is well equipped with modern tools, and the lines now being manufactured are sawmill machinery and turbine water-wheels. In these lines the business has a splendid connection throughout the Dominion, and this could be retained. Highest references given and required. All correspondence confidential. Address, in first instance, Box 522, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS.

Wanted—Position as superintendent, by a practical, up-to-date man, thoroughly familiar with the latest shop methods; 12 years' experience in charge of help; am employed; best of references to those who desire the services of a hustler. Box 553, AM. MACH.

MICHIGAN.

Draftsman, with ability to design, for work on jigs and tools for manufacturing on the interchangeable plan; give full particulars, including experience, wages expected and date when convenient to begin work. Cadillac Automobile Co., Detroit, Mich.

NEW JERSEY.

Toolmaker, experienced; cutters, jigs, fixtures, machine tool repairs. Box 552, A. M.

NEW YORK.

Experienced cost clerk desires position. Box 559, AMERICAN MACHINIST.

Draftsman, mechanical and structural, wants position. Box 533, AMER. MACH.

All-around man wishes position as foreman; large shop preferred. Box 546, AM. M.

First-class mechanical draftsman wants to change position; New York or vicinity. Box 543, AMERICAN MACHINIST.

Toolmaker, thorough mechanic, possessing good business ability, capable to take charge, desires permanent position. Box 551, A. M.

Young technical graduate, with 2 years' experience as assistant superintendent of typewriter works, wishes to make a change. Box 549, AMERICAN MACHINIST.

Position as foreman or superintendent of machine shop, drop forge plant or stamped metal goods. Address "General Foreman," care AMERICAN MACHINIST.

Wanted—Position as modelmaker or on high-class experimental work; varied experience in first-class shops; good references. Box 560, AMERICAN MACHINIST.

Scotch engineer wishes position; age 25; practical and technical training; experienced gas and oil engine work; drafting, installation and testing. Box 544, AMER. MACH.

First-class machinist, at present with large printing house, wants position as constructing engineer; 15 years' experience in various lines of machinery and can furnish A1 references. Box 535, AMERICAN MACHINIST.

Is there a medium-sized machine shop on Manhattan where a bright boy (16) can learn the trade? Intention is to become a good, all-around machinist and toolmaker, not machine-hand. Will make contract. Jos. Vogt, 342 Pleasant ave., New York.

Position chief engineer or master mechanic; thoroughly understand engines, boilers, dynamos, motors, manufacturing machinery, etc.; good executive ability; assume full responsibility; first-class mechanical engineer; first-class references. Address Box 493, AM. M.

Position chief engineer or master mechanic; thoroughly understand engines, boilers, dynamos, motors, manufacturing machinery, etc.; good executive ability; assume full responsibility; first-class mechanical engineer; first-class references. Address Box 545, AM. M.

Young man, 33 years of age, with 3 years' technical education, 7 years' shop and 7 years' drawing-room experience, wants position as draftsman; best of references in regard to general machine work, hoisting machines, pumps and special machinery. Box 541, AMERICAN MACHINIST.

OHIO.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

PENNSYLVANIA.

Wanted—Engineering work, by technical man; 2 years' general experience in rolling mill. Box 542, AMERICAN MACHINIST.

Patternmaker foreman wishes a change; 18 years' experience in marine engines and machine tools; sober; steady. Box 558, AM. M.

Car draftsman wants change position; technical graduate; 2 years' shop experience; 5 years in the drafting room. Box 536, A. M.

Draftsman, with 6 years of experience in mechanical lines, desires situation where he will have chance of advancement. Box 557, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, 4 years' experience, shop and office, wishes position; Eastern locality preferred. Address "F. G. M.," care AMERICAN MACHINIST.

An educated mechanic and business man, with 7 years' experience as toolmaker and machinist, afterward scientific course at university and 3 years' executive experience with the large metal-stamping concern where he learned his trade, would like to correspond with parties requiring a technical executive. Box 507, AMERICAN MACHINIST

First-class mechanic, 37 years of age, with technical training obtained in correspondence school and 8 months' experience in drawing room, has good practical ideas and not afraid to work, and able to handle men, would like position of some responsibility; experienced mostly on engine and sugar machinery. Address A. E. G., care AMERICAN MACHINIST.

VERMONT.

Master Mechanic.—Young man with technical training and 5 years' practical experience, now employed as assistant to master mechanic of paper mill, desires position as

master mechanic of a similar plant. "Mechanic," care AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—Competent toolmakers, experienced on gauges and fixtures. Ross Rifle Co., Quebec, Canada.

Wanted—First-class general foreman for wire insulating factory in Canada, where rubber covered weather proof, magnet and general insulated wires are made; state wages and experience. Box 564, AMERICAN MACHINIST.

ILLINOIS.

Wanted—First-class man, capable of taking charge of automatic gear cutter and milling machines, on general job work; must understand bevel, spiral and worm gear cutting; first-class references required. Box 556, AMERICAN MACHINIST.

Wanted—Expert drop forge die and tool designer on medium work, by large manufacturing concern; must be thoroughly posted on modern shop methods, with ability to handle men; in answering, state full particulars; no applicant will be considered whose record does not prove him to be of the highest grade. Box 463, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

Wanted—Foreman for water tube boiler shops; must have had successful experience elsewhere; good salary to the right man. Address Box 550, AMERICAN MACHINIST.

Experienced office men, draftsmen, foundry chemist, foremen, stock, departmental and cost clerks, and mechanics for large concern with rapidly growing business, including foundry, machine shops and sheet metal and wood-working departments; high-grade work, including automobiles Box 413, AM. MACH.

MASSACHUSETTS.

Wanted—Assistant superintendent and inspector, experienced in gear cutting job shop. Address, with full particulars, Boston Gear Works, Boston, Mass.

To meet our constantly increasing requirements for first-class draftsmen, machinists and molders, we solicit applications in writing, with references. These will be carefully investigated and our selections made from the list of suitable applicants thus maintained. Our plant is entirely new, thoroughly equipped and well located 10 miles from Boston. Refer to this ad., and address Labor Bureau, B. F. Sturtevant Co., Hyde Park, Mass.

MICHIGAN.

Two or three months' work in developing new devices; small brass parts, electrical; very high grade mechanic; state experience fully and salary expected. Box 514, Detroit, Mich.

Wanted—Immediately, several toolmakers; men who have had experience making jigs, fixtures and tools adapted to manufacturing parts of accurate machinery on the interchangeable plan, by modern machinery and appliances. (If you have not had such experience, please do not answer this advertisement.) To experienced and competent men, of good character, who can secure results, steady work and attractive wages; state age, qualifications, references. Cadillac Automobile Company, Employment Bureau, Detroit, Mich.

NEW JERSEY.

Good mechanical draftsman wanted at once; state experience and salary expected. Box 517, AMERICAN MACHINIST.

Wanted—Draftsmen with experience on stranding, twisting or general wire-covering machinery; state experience and pay expected. Box 537, AMERICAN MACHINIST.

Wanted—Machinists familiar with vise work and erecting stationary engines and air compressors; give age, experience and previous employment. Address Box 458, AM. M.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

First-class draftsman, erectors, boring-mill, lathe and planer hands should file application with us, as the constant and rapid growth of our business is always calling for additions to our force; our plant is modern in every respect and is located in a suburb of New York, where there is plenty of room, air and sunlight. Remember, we pay first-class wages and want only competent men. Henry R. Worthington Hydraulic Works, Harrison, N. J.

Wanted—An assistant superintendent for a machine shop near Philadelphia, employing about 400 hands, on small interchangeable work; a thoroughly systematic man, experienced in the handling of men, who can produce, economically, duplicate work in large quantities, without excuses, is required; do not apply if you are not worth $3,000 per year to us; applicants are requested to state where now employed, length of time of such employment, age, reference and qualifications for this position. Address Box 540, AM. M.

NEW YORK.

Wanted—Experienced toolmakers. Address Imperial Engine Co., Painted Post, N. Y.

Wanted—Draftsman, experienced in detail work; good position. Address "C. M.," A. M.

Wanted—Experienced designer on fixtures, tools and jigs. Address "W. G.," care A. M.

Wanted—A number of toolmakers and machinists by the Remington Arms Co., Ilion, N. Y.

First-class men, accustomed to large steam drop hammer. Apply R. Hoe & Co., 2 Sheriff st., New York.

Wanted—A good draftsman on engine details; experience on gas engines preferred; good position for the right man. Box 538, AMERICAN MACHINIST.

Mechanical draftsman, technical graduate, 3 years' experience on hydraulic machinery, desires position; reference if required. Box 547, AMERICAN MACHINIST.

Wanted—Man familiar with wood patterns and core boxes, to number, mark and index them; state experience, references and pay expected. Address Box 554, AMER. MACH.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted—Man to compile bills of material of steam pumps; permanent position; practical shop man preferred; state experience, references and pay expected. Address Box 555, AMERICAN MACHINIST.

Wanted—Day and night foremen for machine department, capable of producing the best possible results with modern tools; good positions for men willing to show results; state age, experience and give references. Box 534, AMERICAN MACHINIST.

Wanted—Superintendent with experience in the manufacture of first-class machine tools; must be energetic, with good executive ability; technical graduate preferred; an excellent opportunity for the right man; state age and past experience. Address "Machinery Manufacturer," care AMER. MACHINIST.

Wanted—Experienced man who thoroughly understands the die-sinking and drop-forging business, capable of making accurate estimates on the cost of dies, labor and setting piece rates; also have executive ability, to take charge of die-sinking and drop-forge department with large manufacturing concern; state age, salary, experience and give references. Box 539, AMERICAN MACHINIST.

Wanted—By a large manufacturing company, a designer for special work; only men with experience and ability need apply; preference will be given to applicants with a good theoretical education and experience in presses and sheet metal machinery; permanent work and best opportunity for advancement, particularly if executive ability should be combined with the above qualifications; give full particulars Box 520, AMER. MACHINIST.

OHIO.

Draftsman wanted; technical graduate with some experience; steady man, willing to learn. Address P. O. Box 876, Cincinnati, O.

Foreman or first-class machinist, capable of handling men to advantage, to take charge of machine department in large manufacturing concern. Address, stating experience and salary expected, Box 521, AMER. MACHINIST.

PENNSYLVANIA.

Wanted—Operators for bevel gear planers. Fawcus Machine Co., Pittsburg, Pa.

Wanted—First-class draftsman on mill construction and equipment; technical man preferred. Box 562, AMERICAN MACHINIST.

Experienced mechanical draftsman wanted at once at steel works in Eastern Pennsylvania. "Mechanical," care AMER. MACHINIST.

Wanted—A few first-class, all-around machinists. Storage Battery Department, The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—Draftsman, thoroughly experienced in designing machines for heavy gear cutting; state salary expected. Box 563, AMERICAN MACHINIST.

Wanted—In southern Pennsylvania, a mechanical draftsman and designer, familiar with machine shop practice, for machine tool work; in reply, state experience, references and wages wanted. Box 548, AMER. MACH.

Wanted—Experienced and thoroughly capable mechanical draftsman and designer; when replying, give extent and kind of experience, and if familiar with other laaguages than English; state salary expected. Address Box 561, AMERICAN MACHINIST.

Foreman to take charge of modern equipped machine shop; 100 men; must be accustomed to modern methods of rapid production in a miscellaneous class of work; reply promptly, giving age, experience and salary expected. Address "X. Y.," care AMERICAN MACHINIST.

VIRGINIA.

Wanted—Mechanical draftsman; preferably one with experience in making elevator plans and layouts. The J. B. Westbrook Foundry & Machine Co., Danville, Va.

WEST OF MISSISSIPPI.

Wanted—A practical machinist to manufacture a steam specialty of high merit. Address P. O. Box 52, St. Paul, Minn.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	137
Acme Machinery Co.	34
Adams Co., The	108
Albro-Clem Elevator Co.	167
Allen, John F.	141
Almond Mfg. Co., T. R.	182
Alteneder & Sons, Theo.	144
American Blower Co.	160
American Gas Furnace Co.	92
American Pulley Co.	129
American Road Roller Co.	162
American Tool Works Co.	8
American Tube & Stamping Co.	136
American Watch Tool Co.	173
Anderson & Sons Co.	152
Armstrong Bros. Tool Co.	105
Athol Machine Co.	158
Atlas Machine Co.	170
Auburn Ball Bearing Co.	158
Audel & Co., Theo.	160
Automatic Machine Co.	102
Automatic Machine Co.	130

	PAGE
Backus Water Motor Co.	154
Badger & Sons Co., E. B.	154
Baird Machinery Co.	174
Baker Brothers	126 and 138
Baldwin Chain & Mfg. Co.	171
Baldwin Steel Co.	134
Ball Bearing Co.	34
Barnes Co., B. F.	144
Barnes Co., W. F. & John	28 and 29
Barnett Co., G. & H.	4th Cover
Bartlett, E. E.	132
Bates Mach. Co.	142
Baush Mach. Tool Co.	114
Bay State Stamping Co.	157
Bay State Tap & Die Co.	167
Beaman & Smith Co., The	15 and 180
Becker-Brainard Milling Machine Co.	23
Bemis & Call Hardware & Tool Co.	124
Bertsch & Co.	168 and 176

	PAGE
Bertram & Sons Co., Ltd., John	95
Besly & Co., Chas. H.	122
Bethlehem Fdry. & Mach. Co.	153
Betts Machine Co.	6
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	159
Bilgram, Hugo	34
Billings & Spencer Co.	161
Binner-Wells Co.	107
Binsse Machine Co.	34
Birdsboro Steel Foundry & Machine Co.	120
Blaisdell Machinery Co.	139
Blanchard Mach. Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	30
Boker & Co., Hermann	91
Boston Gear Works	164
Boynton & Plummer	126
Bradford Machine Tool Co.	5
Bradley & Son, C. C.	169
Bridgeford Mach. Tool Wks.	91

	PAGE
Bristol Co.	4th Cover
Brown Co., H. B.	168
Brown-Cochran Co.	154
Brown & Co., R. H.	180
Brown & Sharpe Mfg. Co.	79 and 4th Cover
Brown Hoisting Mach. Co.	132
Buffalo Forge Co.	4th Cover
Builders Iron Foundry	3d Cover
Bullard Auto. Wrench Co.	99
Bullard Machine Tool Co.	32
Burke Machinery Co.	124
Burr & Son, Jno. T.	170
Butler, A. G.	156
Byram & Co., Inc.	157
Caldwell & Son Co., H. W.	133
Carborundum Co., The	30
Card Mfg. Co., S. W.	16
Carpenter Tap & Die Co., J. M.	168
Case Mfg. Co.	132
C & C Electric Co.	151
Chadwick & Co., G. B.	126

PAGE

Chambersburg Engr. Co.....167
Chandler & Farquhar Co.....176
Chattanooga Machinery Co...130
Chicago Flexible Shaft Co...119
Chicago Rawhide Mfg. Co....164
Christensen, N. A.....132
Cincinnati Machine Tool Co..113
Cincinnati Milling Mach. Co.. 7
Cincinnati Planer Co..... 22
Cincinnati Shaper Co.....190
Clapp Mfg. Co., E. D.....134
Clark Cast Steel Cement Co.173
Clayton Air Compressor Wks.140
Cleveland Auto. Mach. Co.... 18
Cleveland Cap Screw Co.....111
Cleveland Crane & Car Co...132
Cleveland Pneumatic Tool Co.139
Cleveland Twist Drill Co., The.....103 and 4th Cover
Clough, R. M.....155 and 164
Coates Clipper Mfg. Co.....116
Cochrane-Bly Co....132 and 177
Coes Wrench Co..... 20
Colburn Machine Tool Co.... 22
Columbus Machine Co.....154
Cook Co., Asa S.....137
Crane Co.....157
Crescent Forgings Co.....139
Cresson Co., Geo. V.....167
Crocker-Wheeler Co.....148
Cumberland Steel Co.....176
Curtis & Co. Mfg. Co.....150
Curtis & Curtis Co.....142
Cushman Chuck Co.....180
Cutler-Hammer Clutch Co....153

Dallett Co., Thomas H.....128
Davis Mach. Co., W. P.....114
Davis, Rodney..... 164
Desmond-Stephan Mfg. Co....137
Detrick & Harvey Mach. Co..170
Diamond Chain & Mfg. Co... 127
Diamond Machine Co...3d Cover
Dickinson, Thos. L.....137
Dill Machine Co., T. C.....137
Dixon Crucible Co., Joseph...156
Draper Machine Tool Co..... 33
Dreses Machine Tool Co..... 94
Drucklieb, C..... 140
Durbrow & Hearne Mfg. Co..144

Earle Gear & Mach. Co.....164
Eberhardt Bros. Machine Co.164
Eck Dynamo & Motor Wks...150
Electro-Dynamic Co.... 148
Elmes Engineering Wks., Chas. F.....158
Emmert Mfg. Co.....158
Erie Forge Co..... 136
Erie Stamping & Mfg. Co....157
Errington, F. A.....181
Estep & Dolan.....156
Evans Friction Cone Co.....141
Excelsior Needle Co.....100

Fairbanks Co.....125 and 175
Farrel Fdry. & Machine Co..135
Fawcus Machine Co.....166
Fay & Scott.....168
Fellows Gear Shaper Co..... 94
Felton, Sibley & Co.....150
Fenn-Sadler Machine Co..... 30
Firth-Stirling Steel Co.....136
Fitchburg Machine Works....178
Foos Gas Engine Co.....154
Foote Bros. Gear & Mach. Co.167
Foote, Burt & Co.....121
Fosdick Machine Tool Co.... 15
Franklin Mfg. Co.....187
Frasse Co., Peter A.....134

Ganschow, Wm.... 164
Garvin Machine Co., The....171
Geier Co., P. A.....164
Gem Mfg. Co.....124
General Electric Co.....146
General Mfg. Co.....181
General Pneumatic Tool Co..150
Geometric Tool Co..... 23
Gilmore Electric Co.....145
Gisholt Mach. Co..... 12
Gleason Works.....4th Cover
Globe Machine & Stamping Co.167
Goldschmidt Thermit Co.....134
Goodell Mfg. Co.....169
Goodell-Pratt Co.....119
Gorton Machine Co., Geo.....132
Gould & Eberhardt..... 83
Graham Mfg. Co.....158
Grant Gear Works.....164

PAGE

Grant-Nelson Tool Co.....170
Gray Co., G. A..... 34
Greaves, Klusman & Co.....155
Greenfield Machine Co.....117
Greenwald Co., I. & E.....164

Hammacher, Schlemmer & Co. 87
Hampden Corundum Wheel Co.180
Hardinge Bros..... ...122
Harrington, Son & Co., Inc., Edw..... 133
Harrison, H. K.....154
Hart Mfg. Co.....144
Hartford Mach. Screw Co....104
Hartford Steam Boiler Insp. & Ins. Co..... 154
Hawkeye Wrench Co.....159
Heald Machine Co., The.....152
Heller Bros. Co.....134
Hemming Bros..... 160
Hendey Machine Co..... 89
Henley Publishing Co., Norman W..... 93
Henry & Wright Mfg. Co....109
Heppenstall Forge & Knife Co.153
Herron & Bury Mfg. Co.....141
Hess-Bright Mfg. Co.....123
Hill, Clarke & Co....117 and 175
Hill-Standard Mfg. Co.....168
Hilles & Jones Co.....175
Hisey-Wolf Machine Co..... 95
Hoefer Mfg. Co.....160
Hoggson & Pettis Mfg. Co..180
Hopkinson Mach. Works.....158
Horsburgh & Scott Co..4th Cover
Horton & Soa Co., E.....180
Horseless Age, The.....121
Houghton & Co., E. F.....159
Howson & Howson.....167
Hunt Co., C. W.....132
Hunt & Co., Robt. W.....154
Hurlbut-Rogers Co.....145
Hyatt Roller Bearing Co....150

Ingalls & Co.....171
Ingersoll Milling Mach. Co...169
Ingersoll-Sergeant Drill Co...141
International Corres. Schools.107
International Specialty Co...137
Iroquois Machine Co.....171

Jacobs Mfg. Co..180, 183, 184, 185 and 186
Jacobson Mach. Mfg. Co.....154
Jantz & Leist Electric Co....150
Jeffrey Mfg. Co., The.....174
Jenkins Brothers.....157
Johnson Machine Co., Carlyle.139
Jones & Lamson Machine Co. 26, 27 and 34

Kelly Co., R. A.....115
Kempsmith Mfg. Co..... 24
Kent & Co., Edwin R.....134
Keystone Watch Case Co.... 174 and 176
Keuffel & Esser Co.....144
King Machine Tool Co.....173
Knecht Bros. Co.....169

Landis Machine Co.....132
Landis Tool Co..... 81
Lang Co., G. R.....144
Lapointe Machine Tool Co...168
Le Blond Machine Tool Co., R. K....31, 111 and 4th Cover
Le Count, Wm. G.....180
Leland & Faulconer Mfg. Co.131
Link-Belt Engineering Co....189
Lockwood, Arthur J.....137
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co., The...152
Lucas Mach. Tool Co.....161
Lufkin Rule Co.....142
Lunkenheimer Co., The.....157
Lutter & Gies.....156

McCabe, J. J.....115 and 174
McDowell, Stocker & Co.....174
McGlehan & Co., C. H.....171
Maris Bros.....132
Marshall & Huschart Mch. Co.175
Marston Co., J. M.....144
Massachusetts Saw Works....148
Massachusetts Tool Co.....142
Massey Machine Co.....166
Mathews, Hugh.....154
Mechanical Accountant Co...157
Mechanics Machine Co.....130
Mergenthaler Co., Ott.....178

PAGE

Merrell Mfg. Co.....144
Merrill Bros..... 158
Merritt & Co.....128
Messmer Mfg. Co., Ferd.....164
Mietz Iron Fdry. & Mach. Works, August..... 154
Miner & Peck Mfg. Co.....154
Modern Tool Co.....157
Moline Tool Co.....170
Moore Co., Franklin.....131
Morse Chain Co.....189
Morse Twist Drill & Mach. Co. 33
Morton & Co., B. K.....176
Morton Mfg. Co.....140
Motch & Merryweather Mchry. Co..... 175
Mueller Mach. Tool Co.....153

National-Acme Mfg. Co.....190
National Corundum Wheel Co.137
National Machinery Co.....127
National Separator & Machine Co..... 171
New Britain Machine Co.....125
New Era Gas Engine Co.....154
New Haven Mfg. Co.....113
New Process Raw Hide Co...165
New Process Twist Drill Co..171
New York Telephone Co.....144
Newton Mach. Tool Wks., Inc. 11
Niagara Machine & Tool Wks.120
Nicholson File Co..... 17
Nicholson & Co., W. H.....110
Niles-Bement-Pond Co.....
174, 176, 191, 192, 193 and 194
Nolte Brass Co.....168
Northern Electrical Mfg. Co.151
Northern Engineering Works.132
Norton Emery Wheel Co..... 14
Norton Grinding Co.....101
Nuttall Co., R. D.....164
Nutter, Barnes & Co.....178

Obermayer Co., S.....157
O. K. Tool Holder Co.....180
Olds Gasoline Engine Works..154
Orillia, Canada..... 150
Owen Machine Tool Co.....118

Parker Co., Chas.....159
Patchett, T..... 170
Patterson, Gottfried & Hunter, Ltd.....138
Pawling & Harnischfeger.....132
Paxson Co., J. W.....134
Philadelphia Bourse.....129
Philadelphia Gear Works....164
Phillips & Sons Co., F. R....176
Phoenix Mfg. Co.....132
Phosphor Bronze Smelting Co.170
Poole Co., J. Morton.....112
Potter & Johnston Mach. Co. 89
Pratt Chuck Co.....182
Pratt Institute..... 168
Pratt & Whitney Co....2 and 3
Prentiss Tool & Supply Co... 97 and 174
Pryibil, P..... 129

Queen City Mach. Tool Co...109

Rand Drill Co.....140
Ransom Mfg. Co.....162
Reece Co., E. F.....171
Reed Co., H. E.....158
Reed Mfg. Co.....158
Reeves Pulley Co.....125
Reichhelm & Co., E. P..4th Cover
Reisner Mfg. Co., W. H.....123
Reliance Machine & Tool Co.127
Rhodes, L. E.....156
Rich, J. & G.....142
Ridgway Dynamo & Eng. Co. 150
Ridgway Mach. Tool Co.....106
Rivett-Dock Co.....3d Cover
Rivett Lathe.....3d Cover
Robbins, L.....122
Rogers, Boat, Gage & Drill Works, John M..... 92
Rogers & Hubbard Co.....134
Rotary File & Machine Co...157
Roth Bros. & Co.....151
Royersford Fdry. & Mach. Co.153
Rowbottom Machine Co.....120

Safety Emery Wheel Co.....145
Saunders' Sons, D.....167
Sawyer Gear Works.....164
Schellenbach & Radcliffe.....127
Schieren & Co., Chas. A..... 96
Schumacher & Boye..... 9

PAGE

Schwerdtle Stamp Co.....134
Scranton & Co.....171
Sebastian Lathe Co.....130
Sellers & Co., Inc., William.. 34
Seneca Falls Mfg. Co.....129
Shepard Lathe Co.....168
Shultz Belting Co.....123
Sibley Machine Tool Co.....181
Silk Machine Tool Co., P. P...156
Simonds Mfg. Co.....164
Simplex Time Recorder Co....173
Skinner Chuck Co.....180
Slocomb Co., J. T.....121
Smith, E. G.....142
Smith & Mills.....168
Speed Changing Pulley Co...125
Sprague Electric Co.....146
Springfield Machine Tool Co..131
Standard Connecting Rod Co.155
Standard Engineering Works.156
Standard Gauge Steel Co....169
Standard Roller Bearing Co..112
Standard Tool Co.....187
Stanley G. I. Elec. Mfg. Co...149
Stark Tool Co.....168
Starrett Co., L. S.....143
Steffey Mfg. Co.....154
Steptoe Shaper Co., John....152
Stevens, F. B.....157
Stoever Fdry. & Mfg. Co.....167
Stow Mfg. Co.....148
Straley & Hasbrouck.....168
Street Bros. Machine Works..123
Struthers-Wells Co.... 154
Sturtevant Co., B. F.....13
Swaine Co., Fred. J.....155
Syracuse Raw Hide Co.....167
Syracuse Twist Drill Co.....142

Tabor Mfg. Co.....126
Taylor-Wilson Mfg. Co.....166
Three Rivers Tool Co..... 87
Tindel-Morris Co.....155
Toomey, Frank..... 176
Triumph Electric Co.....147
Trump Brothers Machine Co.180
Tulley & Co., Henry C.....171

Underwood & Co., H. B.....128
Union Drawn Steel Co.....135
Union Twist Drill Co..... 85
Universal Drafting Mach. Co.143
U. S. Foundry & Sales Co....134

Vandyck Churchill Co..... 19
Vickers, Sons & Maxim.....137
Vitrified Wheel Co.....177
Von Wyck Mach. Tool Co....138

Wallace Supply Co.....156
Walker & Co., O. S.....181
Ward & Sons, Edgar T.....134
Warner Instrument Co.....116
Warner & Swasey Co..... 85
Waterbury Farrel Foundry & Mach. Co..... 124
Watson-Stillman Co..... 108
Webster & Perks Tool Co....169
Wellman Sole Cutting Mach. Co..... 139
Wells Bros. Co..... 31
West Haven Mfg. Co.....
126 and 4th Cover
Westcott Chuck Co.....181
Western Tool & Mfg. Co.....128
Westinghouse Elec. & Mfg. Co.147
Westmacott Co., J. M.....92
Whatley, A. H.....154
Whitcomb-Blaisdell Machine Tool Co..... 21
Whitman & Barnes Mfg. Co..177
Whitney Mfg. Co..... 1
Whiton Mach. Co., D. E.....181
Wiley & Russell Mfg. Co.....177
Wiley & Sons, John..... 34
Williams Tool Co.....130
Williams & Co., J. H.....170
Williamson Mfg. Co.....158
Wilmarth & Morman Co.....156
Windsor Machine Co.....118
Winkley Co.....157
Wood's Sons, T. B.....138
Woodward & Powell Planer Co..... 110
Worcester Mach. Screw Co...171
Wormer Machinery Co., C. C..176
Wyman & Gordon.....4th Cover

Yale & Towne Mfg. Co.....133

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

Air Lifts

Ingersoll-Sergeant Drill Co., New York.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Ball Bearings

See Roller Bearings.

Band Saws, Metal

Greaves, Klusman & Co., Cin., O.
Niles-Bement-Pond Co., New York.

Barrels, Tumbling

Globe Machine & Stamping Co., Cleveland, O.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Grant-Nelson Tool Co., Chicago, Ill.
Mathews, Hugh, Kansas City, Mo.
Niles-Bement-Pond Co., New York.

Bars, Boring—*Continued*
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing
Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.

Bending Machines, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bertsch & Co., Cambridge City, Ind.
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Swaine Co., Fred J., St. Louis, Mo.

Bending Tools, Hand
Estep & Dolan, Sandwich, Ill.
Wallace Supply Co., Chicago, Ill.

Blocks, Chain
See Hoists, Hand.

Blocks, Swivel
Patchett, T., Stoneham, Mass.

Blowers
American Blower Co., Detroit, Mich.
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines
Keuffel & Esser Co., New York.

Boilers
Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery
Acme Mchry. Co., Cleveland, O.
Brown Co., H. B., Easthampton, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Landis Mach. Co., Waynesboro, Pa.
Lang Co., G. R., Cincinnati, O.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Williams Tool Co., Erie, Pa.

Bone for Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Books, Mechanical
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Modern Machinery Pub. Co., Chicago, Ill.
Wiley & Sons, Jno., New York.

Boosters
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Broaching Machines
Burr & Sons, John T., Brooklyn, N. Y.

Bulldozers
National Machinery Co., Tiffin, O.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Walker & Co., O. S., Worcester, Mass.

Calipers
Athol Machine Co., Athol, Mass.
Mass. Tool Co., Greenfield, Mass.
Smith, Ernst G., Columbia, Pa.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

Castings, Brass
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co. Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Motor
Harrison, H. K., St. Paul, Minn.
Steffey Mfg. Co., Phila., Pa.

Castings, Steel
Baldwin Steel Co., New York.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Catalogue Makers
Binner-Wells Co., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Fay & Scott, Dexter, Me.
New Haven Mfg. Co., New Haven, Conn.
Pratt & Whitney Co., Hartford, Conn.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Westcott Chuck Co., Oneida, N. Y.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Westcott Chuck Co., Oneida, N. Y.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Magnetic
Walker & Co., O. S., Worcester, Mass.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.
Hardinge Bros., Chicago, Ill.

Circuit Breakers
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.

Clutches, Friction—*Cont'd*
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

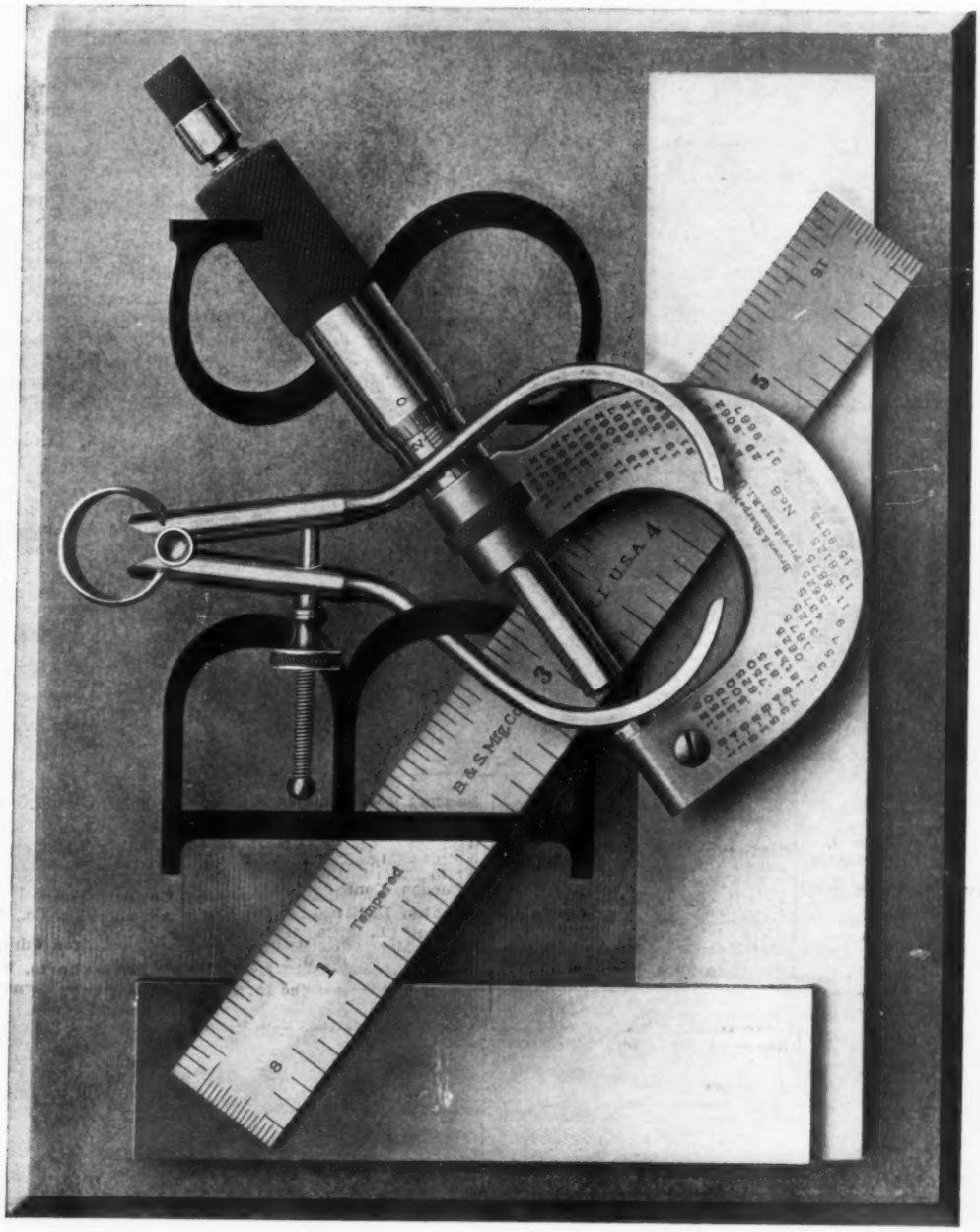
Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Byram & Co., Inc., Detroit, Mich.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.

BROWN & SHARPE MFG. CO.,
PROVIDENCE, R. I., U. S. A.



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Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Byram & Co., Inc., Detroit, Mich.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Bolt
Brown Co., H. B., Easthampton, Conn.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burr & Sons, John T., Brooklyn, N. Y.
Davis Mach. Co., W. P., Rochester, N. Y.
Goodell Mfg. Co., Greenfield, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Western Tool & Mfg. Co., Springfield, O.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Gem Mfg. Co., Pittsburg, Pa.
Lutter & Gies, Milwaukee, Wis.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Swaine Co., Fred J., St. Louis, Mo.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Dowel Pins
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.
Rich, J. & G., Philadelphia, Pa.

Drawing Materials
Alteneder & Sons, Theo., New York.
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Moline Tool Co., Moline, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.

Drilling Machines, Upright *Continued*
Burke Machinery Co., Cleve., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.,
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Knecht Bros. Co., Cincinnati, O.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

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C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
National Elec. Co., Milwaukee, Wis.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Cutler-Hammer Clutch Co., Milwaukee, Wis.,
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.

Electrical Supplies—*Cont'd*
Northern Elec .Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Street Bros. Machine Co., Chattanooga, Tenn.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Dickinson, Thos. L., New York.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting
McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Backus Water Motor Co., Newark, N. J.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mathews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Binner-Wells Co., Chicago, Ill.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Extinguishers, Fire
Badger & Sons Co., E. B., Boston, Mass.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

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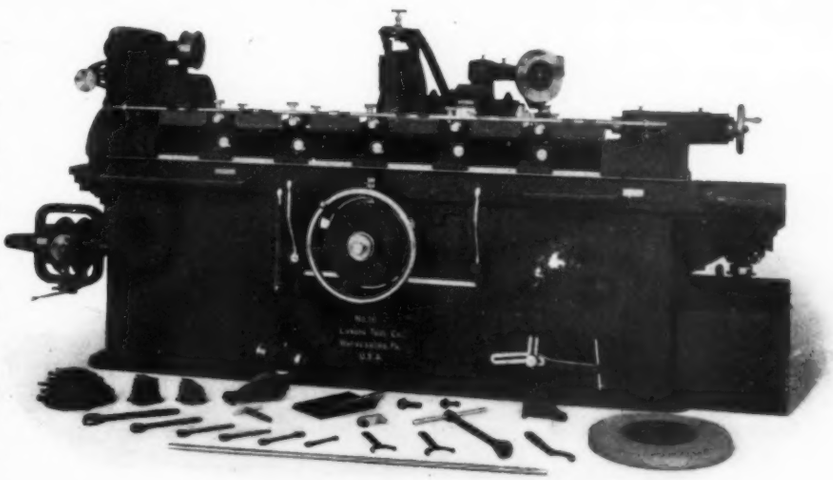
and if it does not mention specifically that your Grinding Machines should be the "LANDIS" make—it should, and we can prove to you the absolute necessity of such specification.



No. 16 Plain Grinding Machine, 12 in. swing, 72 in. between centers.

Here is one of the Landis new Plain Manufacturing Grinders, made in four sizes, viz : 12-in. swing, 48-in., 72-in., 96-in., 120-in. between centers. Equipped with powerful geared head and quick speed change traverse drive. Grinding wheel 20 in. diameter 2 in. face, ordinarily will remove 1½ cubic inches of metal per minute, and finish within a .00025 in. limit. We manufacture 50 different styles and sizes of Grinding Machines, including Universal, Plain, Internal, Crank Grinders, etc.

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and can meet your requirements, no matter what you have to grind; send us blue prints and let us figure on your work. Let us send you catalogs.

10 Pieces--Emery Wheel Spindles, 3¼ in., 3½ in., 3⅝ in., and 4½ in. diameter, 26½ in. long; .050 in. removed; average time, 1 hour.

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Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

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Cochrane-Bly Co., Rochester, N. Y.
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Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Burke Mach. Co., Cleveland, O.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New York.
National Machinery Co., Tiffin, O.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Anderson & Sons, W. H., Detroit, Mich.
Billings & Spencer Co., Hartford, Conn.
Clapp Mfg. Co., E. D., Auburn, N. Y.
Crescent Forgings Co., Oakmont, Pa.
Lang Co., G. R., Cincinnati, O.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Anderson & Sons, W. H., Detroit, Mich.
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Byram & Co., Inc., Detroit, Mich.
Gem Mfg. Co., Pittsburg, Pa.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

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Ingalls & Co., Castleton, N. Y.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Mass. Tool Co., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear & Machine Co., Chicago, Ill.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Sturtevant Co., B. F., Boston, Mass.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Cutter
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Lutter & Gies, Milwaukee, Wis.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.

Grinding and Polishing Machines—*Continued*
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Walker & Co., O. S., Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.
Massachusetts Saw Wks., Chicopee, Mass.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.

Some Interesting Things from the Union Iron Works.

EDITORIAL CORRESPONDENCE.

The reputation of the Union Iron Works, of San Francisco, was established, in the mind of the general public at least, by the performance of the Oregon, and the possessor of the high expectations naturally based on that performance finds no disappointment when visiting the works, of which the equipment is of the best class, giving the impression at every turn that the work turned out is of the highest grade. One is at once struck by the number of English tools comprised in the equipment, while German tools are not absent. Located as the works are, in a locality to which freight rates from all tool building centers are high, they have designed and made many tools, especially large ones, themselves—tools which bear none of the usual characteristics of "home-made" work, but, on the other hand, look as though they might have come from a machine tool shop. The best known of these tools is probably the 30 foot boring mill of unique design, which was illustrated at page 674, Vol. 21, and hence is omitted here.

A WALL PLANER.

Fig. 1 is a not less novel machine which might be called a wall planer, though it does not happen to be located against a wall. The general character of the machine as well as of the work done by it is obvious from the illustration, which shows a heavy bed piece in position to have its bottom planed. The tool head at the right is so arranged that a clapper box may be applied to any one of the three sides. The tool head reciprocates either vertically or horizontally—vertically on the bar which guides it and horizontally with this bar on the main frame of the machine. The movements are effected by screws of which two—one in the upper and one in the lower rail of the frame—are provided for the horizontal movement. The reversal is by shifting belts, the pulleys for effecting the horizontal movement being at the right and for the vertical movement at the left of the picture. The large capabilities of such a machine in connection with marine engine and other large work will be apparent.

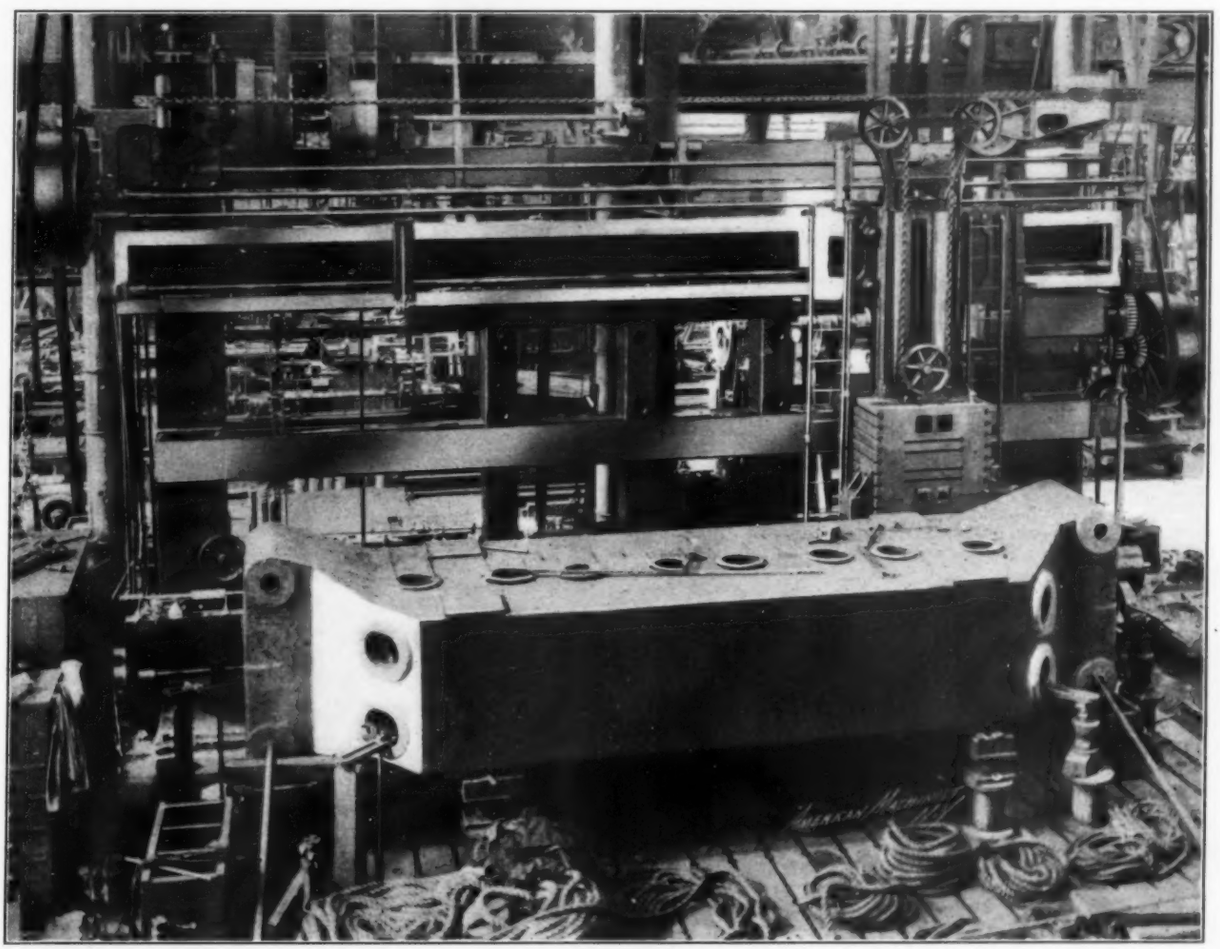


FIG. 1. WALL PLANER.

ELLIPTICAL MANHOLE CUTTING MACHINE.

Fig. 2 is a machine for cutting elliptical manholes in boiler plates. The plate to be cut is strapped to the table, a parting tool being carried by the arm of the revolving tool head. The entire tool head with its spindle and support is fitted to slide transversly for a short distance on the main frame. The upper end of the spindle carries a spur gear below the bevel driving gear, this spur meshing with and driving another gear of equal size mounted on the main spindle support. The lower end of the shaft of the second gear has a slotted crank arm in which is mounted a crank pin connected to the horizontal link shown, of which the right-hand end is pivoted to the main frame. It is obvious that with the gear in action the entire tool head will reciprocate horizontally on the frame by a distance equal to the diameter of the crank circle on the spur gear shaft, and that this movement will be added to the diameter of the circle traversed by the tool about the center of its own spindle in the direction of the slide movement, while no such addition will be made in the direction at a right angle to this. The amount of this addition and hence the

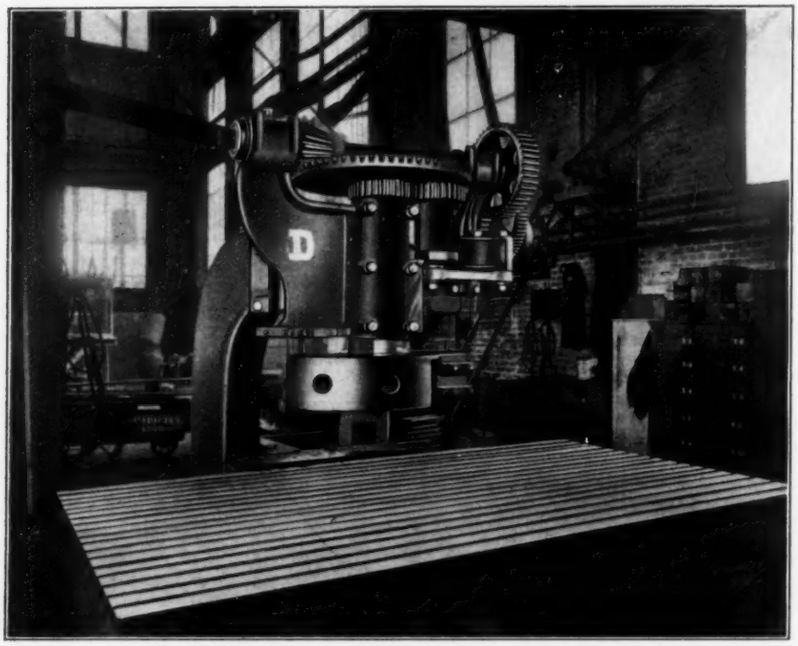


FIG. 2. ELLIPTICAL MANHOLE CUTTING MACHINE.

eccentricity of the ellipse is adjusted by the adjustment of the crank pin in the slotted cross arm, while the size of the hole is determined by adjusting the tool block radially on the tool head—horizontal slides being provided for this purpose, as well as vertical slides for feeding the tool through the sheet.

PROPELLER BLADE PITCH MEASURING MACHINE.

Fig. 3 shows a machine for measuring the pitch of propeller blades which is believed to be an entire novelty. The blade to be measured is mounted on the T-slotted flat plate shown just within the hand rail, and provided with means for vertical adjustment, in order to bring the face by which the blade is to be mounted on its hub at the proper distance from the center. The blade is squared and adjusted on this plate with its acting side facing the fan-shaped sheet of boiler plate in the background. At distances of 6 inches on this sheet and radiating from the center of the blade support are three series of holes carrying notched pins, these pins carrying in turn a flexible straight edge. The right-hand pin seats against a shoulder, the middle pin serves only to bend the straight edge to an approximately circular form, while the left-hand pin does the measuring. Below the left-hand side of the fan-shaped sheet and within the hand rail is a hand wheel which serves to move the fan and straight edge up to contact with the blade. The straight edge abuts against the blade at its right hand when the left-hand pin is adjusted endwise until the straight edge has as fair contact as possible with the surface of the blade when the pitch is read from a series of graduations on the left-hand pin. It will be observed that the angle subtended is the same for all radial positions, which means that a constant fraction of the circumference is always included between the pins and that a single set of graduations answers for all radial positions, which being the case, the graduations are made to give by direct reading the pitch of the blade in feet. In measuring a blade a reading is taken for each radial set of holes, the blade being thus mapped, so to speak, for its entire length.

The chief use of the machine is in connection with the bolting of the blades to their hubs. The average of all the readings is taken as the true pitch of the blade and, should they differ, the blades are twisted slightly on the hub before bolting in place in order to insure that all have the same pitch and that this pitch is the one called for in the design.

The object of mounting the machine at an elevation from the floor is to permit its swinging propellers cast in one piece, for which purpose a portion of the platform and hand-rail is, of course, removed. With propellers of this type, no adjustment of the blades is possible, but their degree of conformity with the design may be learned, and in the case of ships undergoing repairs their characteristics may be learned, and in the case of broken propellers the pitch which a new one should have is readily learned.

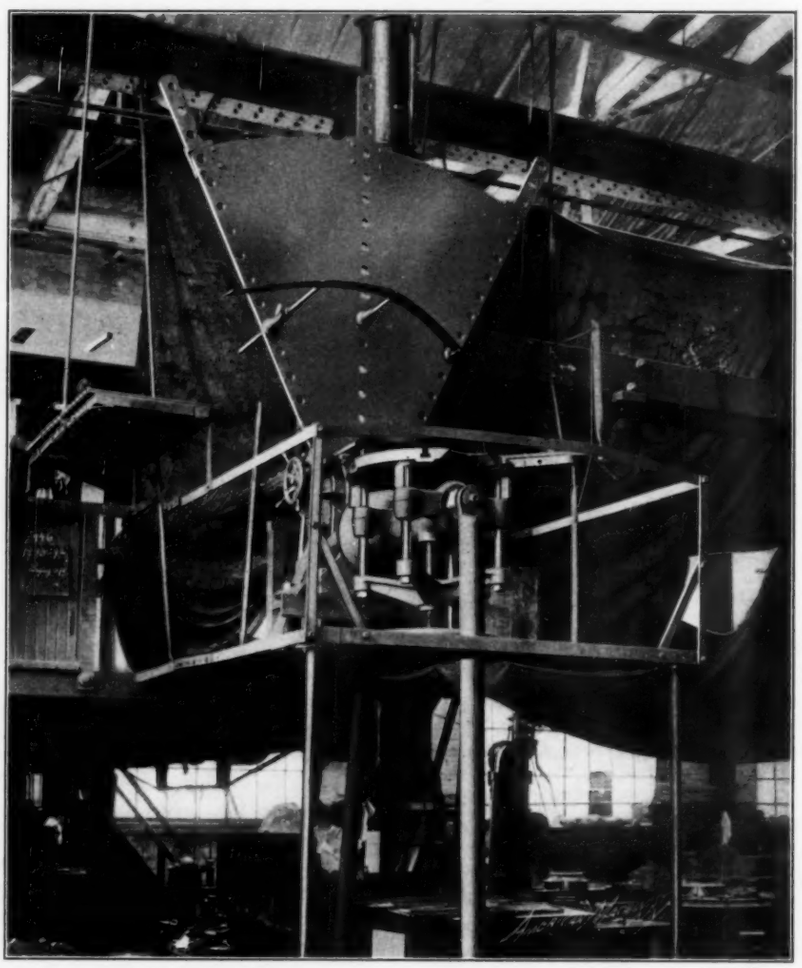


FIG. 3. MACHINE FOR MEASURING THE PITCH OF PROPELLER BLADES.

HYDRAULIC MACHINERY.

These works make large use of machines operated by hydraulic pressure. The most striking case of this kind is a hydraulic dry dock, by which ships are lifted from the water by hydraulic cylinders instead of by flotation. As this is far removed from the field covered by the AMERICAN MACHINIST, no picture of it is given.

Hydraulic cranes are numerous about the works, and Fig. 4 shows two of those which serve steam hammers in the blacksmith shop. Except for racking in and out, which is by a hand chain, the operation of the machine is entirely by hydraulic pressure, the control being by a series of valves located at the base of the column. The lifting cylinder is located at the top of the column, as seen most clearly in the crane in the background, while the swinging of the jib is by the cylinders under the inner end of the jib. The cranes carry sheaves which work in bights of the chain, of which the fixed ends are fastened to a bracket on the column, the chain passing around a sprocket wheel attached to the jib. When pressure is admitted to one cylinder, the jib swings toward the hammer and *vice versa*. Many cranes operating on this principle are located about the works, and their action in entire silence is extremely attractive. The forge in the foreground of Fig. 4 is fired by gas, as are all the others in this shop, which, in consequence, is as free from smoke as an office. The interior is, in fact, whitewashed, although it is somewhat discolored, due to the fact that the whitewashing was done before the use of coal was entirely discontinued. More will be said of this use of gas in another article.

FIG. 4. HYDRAULIC FORGE CRANE.

FIG. 5. PIPE-FLANGE WELDING MACHINE.

Fig. 5 shows a hydraulic press for welding flanges to pipe, which construction is largely followed at these works. The pipe and flange being properly heated, they are dropped in the lower die and the upper die is brought down to prevent displacement of the flange, but without squeezing it. The horizontal plug is then run into the pipe, this being done by air pressure, when a powerful squeeze is given by the top die and the job is finished in less time than is required to tell of it.

Fig. 6 shows a powerful hydraulic bulldozer, which speaks for itself. The machine is shown with dies in place for bending ship plates, and it will be seen to have a large range of capacity.

OTHER SHOP TOOLS.

Fig. 7 is another picture which tells its own story. It is a radial boiler shell drilling machine for drilling holes in place. The adjustment of the drills to the work is by the circular track which forms the base of the machine.

Fig. 8 shows a horizontal drilling and milling machine arranged for milling oil grooves in crosshead guides, the action of this also being almost self-explanatory. The plate to be milled is mounted upon a swivel support and is tilted to a position which brings the desired direction of cut in a horizontal position, the column of the machine being fed horizontally on its base. The work support of the machine is universally adjustable as regards angles, and Fig. 9 shows it adjusted for drilling the oil holes at the ends or the grooves.

Fig. 10 shows a pipe-bending machine for the pipes of water-tube marine boilers. In the type of boilers here built, the tubes have to be bent to a great variety of forms, as shown at the left of Fig. 11. In most cases the bend is a simple curve, though of varying radius in different tubes, but in some a sinuous curve must be added. This latter is produced by the bending forms shown in the left foreground of Fig. 10, the simple curves being produced by sweeping a collar around a suitable form, of which several are shown in the right foreground. This sweeping is done by an electric motor mounted at the inner end of the sweep arm, which, by a shaft and bevel gear, transmits its motion to a pinion at the end of the arm, this pinion meshing with a circular neck located at the extreme end of the table and beyond the curved form. Two tubes are bent simultaneously, and the piles of tubes in the background will serve to indicate that the machine has work to do.

F. A. H.

A School Manager on the Metric System.

In the annual report of the British Weights and Measures Association a contributor who signs himself "School Manager" presents a copy of a circular appeal received by him urging him to be more active in the work of helping to introduce the metric system and not to be "inert." The appeal is issued by one K. Morven, and "School Manager" thus comments upon it:

"I am quite in favor of a metric system, but I am not prepared to live and die for it exactly. There is a good deal to be said on the other side. A decimal notation is not everything. One of our greatest philosophers was dead against it. I mean, *is* dead against it, because he is now actually dead, and when I said that he *was* dead it might suggest that he is not dead now. I wish he wasn't—I mean, I wish he isn't—no, I mean—But the gentle reader will understand what I mean; this kind of thing makes me wish for a metric system of grammar. In a metric system you shift the decimal point, I believe, so that the point in metrical system cannot be accused of inertness. Abroad I have had difficulties with the metric system, however. I am never sure whether to ask for a kilogram of cognac or a hectoliter of bread. Upon the whole, I fear I *am* an inert metronite, so that 'K. Morven' hit the mark when he posted his circular to me."

It is reported that the director of the French School at Athens has just discovered at Delos three large lead vases full of old coins. The largest contained more than 300 four-drachma pieces minted in Athens under the Archons. They are said to be in such perfect state that they would appear never to have been put in circulation.—*The Engineer.*

Report of the British Weights and Measures Association.

We have previously mentioned the fact that in England there is what is known as the British Weights and Measures Association, the object of which is to preserve the present standards of weights and measures used in Great Britain and oppose the efforts of those who believe that Great Britain would gain by the adoption of the metric system and are trying to show that such would be the case. We have just received the "Annual Report" of the association named, which besides being a report contains a collection of articles, largely from American sources. From the report proper we quote as follows:

Looking back over the period that has elapsed since the British Weights and Measures Association was formed, it is obvious that further delay in organizing opposition to the introduction of the meter into this country would have been well-nigh fatal.

Twelve months ago the supporters of the metric system were exceedingly active, and their activity had been further stimulated by the bill, which they had had prepared, passing through the House of Lords on May 17. The object of this bill was to compel the people of this country to use the metric system whether they liked it or not, and to make illegal those weights and measures on which the commercial supremacy of the British Empire has been built. Fortunately the House of Commons displayed no hurry in dealing with the bill sent down to them by the Upper House, and the bill, having got no further than its first reading when Parliament was prorogued, became a dead measure. Early in March of this year a movement was made in the direction of re-introducing the bill, but the Government's decision was against it. . . . .

We would like to emphasize the fact that among none of the British-speaking peoples of the world is the metric system acceptable. It has been legal for all purposes in the United States of America since 1866, and in this country since 1897, and still it is not used for manufacturing or commercial purposes. In making the system legal, and putting it on an equal footing with the Imperial weights and measures, the metricites do not recognize that all has been done that can be done in a country governed by the will of the people. The only further step that can possibly be taken is the thoroughly un-English method of compulsion, and the Anglo-Saxon race does not favor compulsion, more particularly when the system to be imposed upon them is not so suitable for their business purposes as that sought to be taken from them.

There is undoubtedly a growing feeling in this country in favor of decimalizing our units wherever possible, for computative work and bookkeeping purposes. We have had many instances of gentlemen who favor decimalizing having been misled by the title of the association most active in trying to bring about the enforcement of the metric system, and who

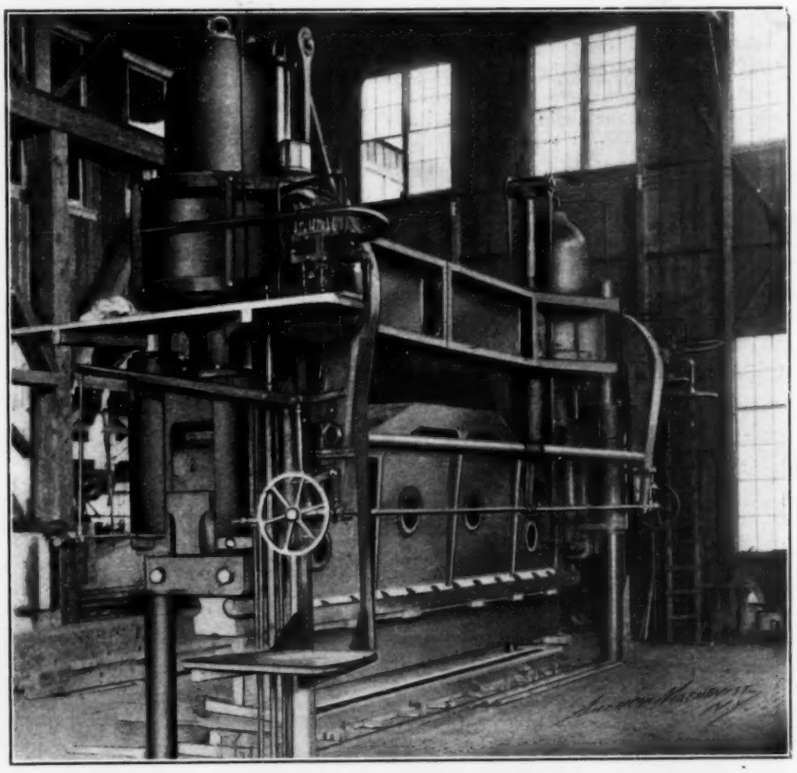


FIG. 6. HYDRAULIC BULLDOZER.

had joined that association believing that it was a decimal association, but who, on finding out that it was really a metric association, immediately left it. A large number of the resolutions which have been passed in favor of the metric system by public and semi-public bodies, and made use of by the metricites to further their aims, have been passed under a misapprehension. The metric system has been confused with decimalizing pure and simple. Our own position on this point we define in the language we used in our original manifesto—that is, "We wish it to be clearly understood that we have no desire to fight against the use of decimals, but we object to being tied solely to their use. Decimalizing is a common and convenient method of calculating." One of the strongest objections to the metric system is that it ties the user to decimals alone. There are many calculations which can be done more simply by other methods, and we will not be a party in restricting and lowering the standard of arithmetical efficiency in this country.

The investigations which we have been able to make during the past year have made clear to us that the British public has also been misled in another direction. In a return which has been handed in to the House of Lords committee by the supporters of the metric system, there is a list of 36 countries which are said to have adopted the metric system. This statement lacks clearness as to what the actual facts are. As it stands, it gives readers the impression that in these 36 countries the metric system is universally in use, whereas it should state that in these 36 countries governments have passed laws with the object of making the metric system the only system legally recognized, but in many cases the act is a dead letter so far as the people are concerned. In many of those countries the passing of the law, and its enforcement, or partial enforcement, by government, entails a distinct disability on the people. There are several of the countries not using the system at all, but for importing and exporting purposes, and when goods of necessity pass through the customs office the governments enforce its employment. The result in many cases is ludicrous. Importing, say, from England, where the yard and pound are used, the English merchant is put to the trouble of converting his weights and measures to the metric system solely for the convenience of the customs offices of the importing country. Immediately the goods arrive in that country the importer then has the trouble of re-converting the metric weights and measures to yards and pounds, probably, for commercial purposes. That list, too, of "36 countries" is made up of small states, which in some cases have not the population of many an English city, and in many cases can hardly be said to have settled forms of government. Against these are counted the British Empire, the Russian Empire, and the United States of America, as three countries against 36, the inference being—and, in fact, it is often stated—that "the whole of the civilized world, with one or two exceptions," has adopted the metric system. It is not pointed out that the British Empire alone has a larger population than all the metric-using countries added together, nor is the further important fact pointed out that throughout the English-speaking race there is only one yard and one pound, and that the measures of the Russian Empire are based on the English inch. . . .

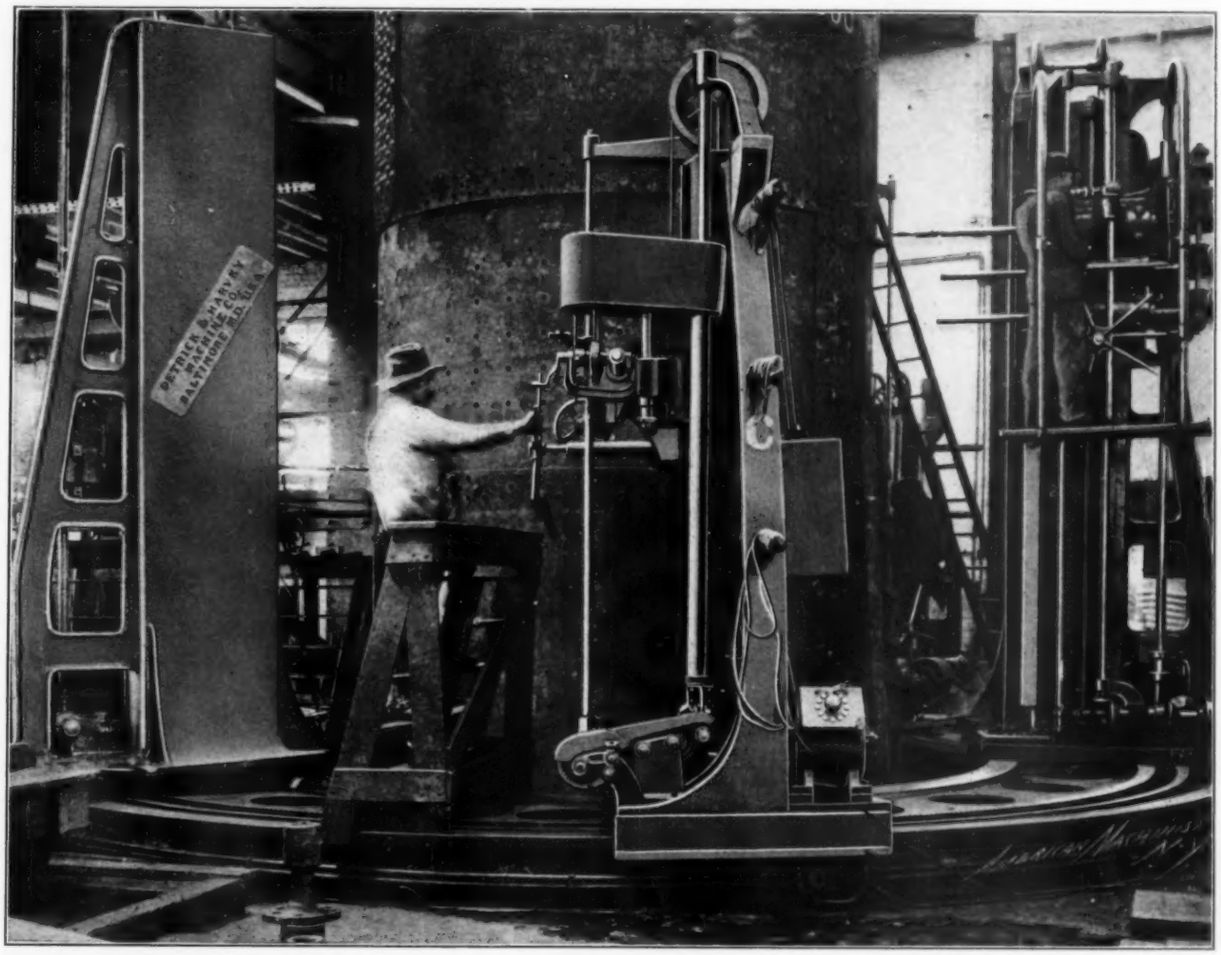


FIG. 7. BOILER-SHELL DRILLING MACHINE.

While during the year just closed we have devoted our attention to the first part of our objects—namely, opposing the introduction of the meter or any of its derivatives into the British Empire, we have not lost sight of the remaining part of our

work. In conducting our investigations with a view to ascertaining the true state of affairs as to the adoption and use of the metric system, we have learned much that will be of value in our future work. The mistakes of the metric reformers were quite as great in what they omitted as in what they did. We hope to benefit by their experience.

At the present time there does not appear to be any country in the world that has a system of weights and measures of simple application to science, manufacture and commerce, and yet that is a desideratum, and one which the English-speaking race is nearer accomplishing than any other nation. The metric system has been made of the greatest value for scientific purposes, but for manufacturing and commercial purposes it has made little headway. In no country has it displaced units which are to be found in their greatest state of efficiency in our Imperial weights and measures. The weights and measures of the English-speaking peoples, while being, even at the present time, of exceptional value for manufacturing and commercial purposes, have not had the principle brought into them which merits their universal use for scientific purposes. We believe, however, that this value can be given to them in the greatest measure by very slight alteration, and without any disparagement of their merits for manufacturing purposes. Further, by eliminating the superfluous and standardizing the useful, we can make them still more valuable for purposes of manufacturing and commerce.

Examining closely the merits and demerits of the metric system, its principal values, from a scientific point of view, appear to be obtained in the co-relation of its units and, for purposes of computation, in its decimal multiples. Respecting the value of co-relation, it is not a principle which owes its discovery to those who adopted the meter. The principle of making measures of volume the cubes of assigned length, and standards of weight the weight which that cubic vessel would hold of some given substance, is many, many centuries older than the meter. The Romans and Egyptians had the principle embodied in their weighing and measuring systems, and, what is perhaps of greater interest, the ancient British weights and measures also had the principle of weight co-related to volume in its simplest form. The ancient British weights and measures were not only co-related, but their multiples were systematic, based on the binary system. Confusion has been introduced into them by what, in the light of present-day experience, appears to have been a foolish desire of those English traders doing business abroad to assimilate their principal weights to those of the Continent; and, further, by unregulated custom on the part of home traders.

The co-relation of the metric units is to be seen in the fact that the meter is the linear standard; the one-thousandth part of the cubic meter, known as the liter, the volume standard; and the one-thousandth part of the weight of water contained in a liter, known as the gram, the weight standard. These units, in terms of the meter—the base of the system—may be thus expressed:

	Meter.	Meter.
Linear standard	1	1
Volume standard	.001	$\frac{1}{1000}$
Weight standard	.000001	$\frac{1}{1000000}$

We suggest that this principle of co-relation can be applied to our system in an even simpler form than in the metric system, by making the inch the linear standard, the cubic inch the volume standard and the weight of water in a cubic inch the weight standard. These units

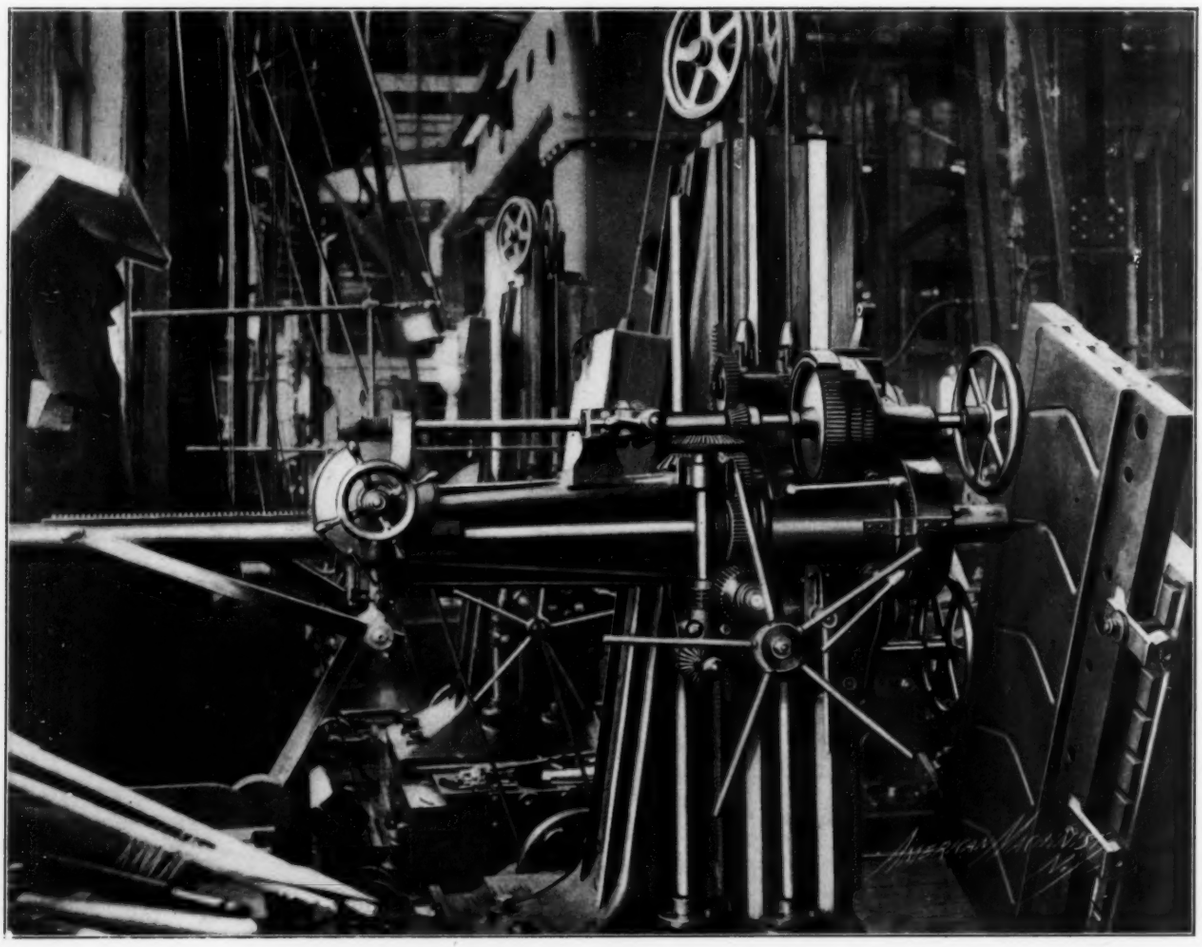


FIG. 8. MILLING OIL GROOVES ON CROSSHEAD GUIDES.

expressed in terms of the inch—the base of the system—would be then thus expressed:

	Inch.
Linear standard.....	1
Volume standard.....	1
Weight standard.....	1

We thus eliminate fractional base values, and secure a set of units of the greatest simplicity, and containing that co-related principle which gives value to them for scientific purposes. On this base ratios can be introduced, as they may be from time to time demanded, by the various trades, and upon that base scientists can build decimal multiples and sub-multiples for facility of computation. We thus obtain a foundation on which the scientist can at once obtain every facility in as great, if not a greater degree, than is given by the meter, and we provide for reform in our manufacturing and trade units on a scientific base; thus by way of evolution as against revolution we produce a system of weights and measures suitable alike for science, manufacture and commerce.

Possibly the greatest mistake of all that the designers of the metric system made was the rule they laid down as a *sine quâ non* of any system they should recommend—namely, that the base unit should be a length different to any existing unit of any nation. We think just the opposite would have been the recommendation of a body of practical men, and we have followed that line in recommending the inch units. The inch, either exactly or approximately the English inch, is the most valuable unit for manufacturing purposes, and is used by every manufacturing people in the world. Building on this, we obtain the scientific value previously referred to, on the same base as the great industrial unit—the inch, a unit not only of the English-speaking peoples, but of all manufacturing nations. While the scientist and the computator generally can readily adapt decimal ratios to these units, it requires the most careful consideration on the part of manufacturers as to what ratios shall be recommended to displace those in present use. It is a question of the greatest import to manufacturers and traders generally, and one which will have to be considered in its relation to each particular trade, as well as in relation to trade as a whole. But, while considering it from the particular and general trade standpoint in England, it is no less essential that it shall be equally seriously considered by the British colonies and by the United States. The question is eminently one for the English-speaking race inasmuch as they already have one common uniform system of weights and measures, and any movement in the way of reform should be made simultaneously by the whole race.

It is on these grounds that we refrain from even suggesting at this stage what the ratios should be fixing the various denominations. Such recommendations can only come after the most searching consideration of every aspect of the case which can be presented. There are obviously some reforms which will meet at the outset with practically universal approbation, and there is no reason why these reforms should not be carried out as their utility is recognized. The greatest danger to be guarded against is that of adopting hasty and ill-considered measures. It is as true to-day as when Secretary John Quincy Adams, of the United States, penned his words, that "The reform, if ever effected, can only be by consent, and not by force." This consent we cannot expect to have without much educational work. Reform of weights and

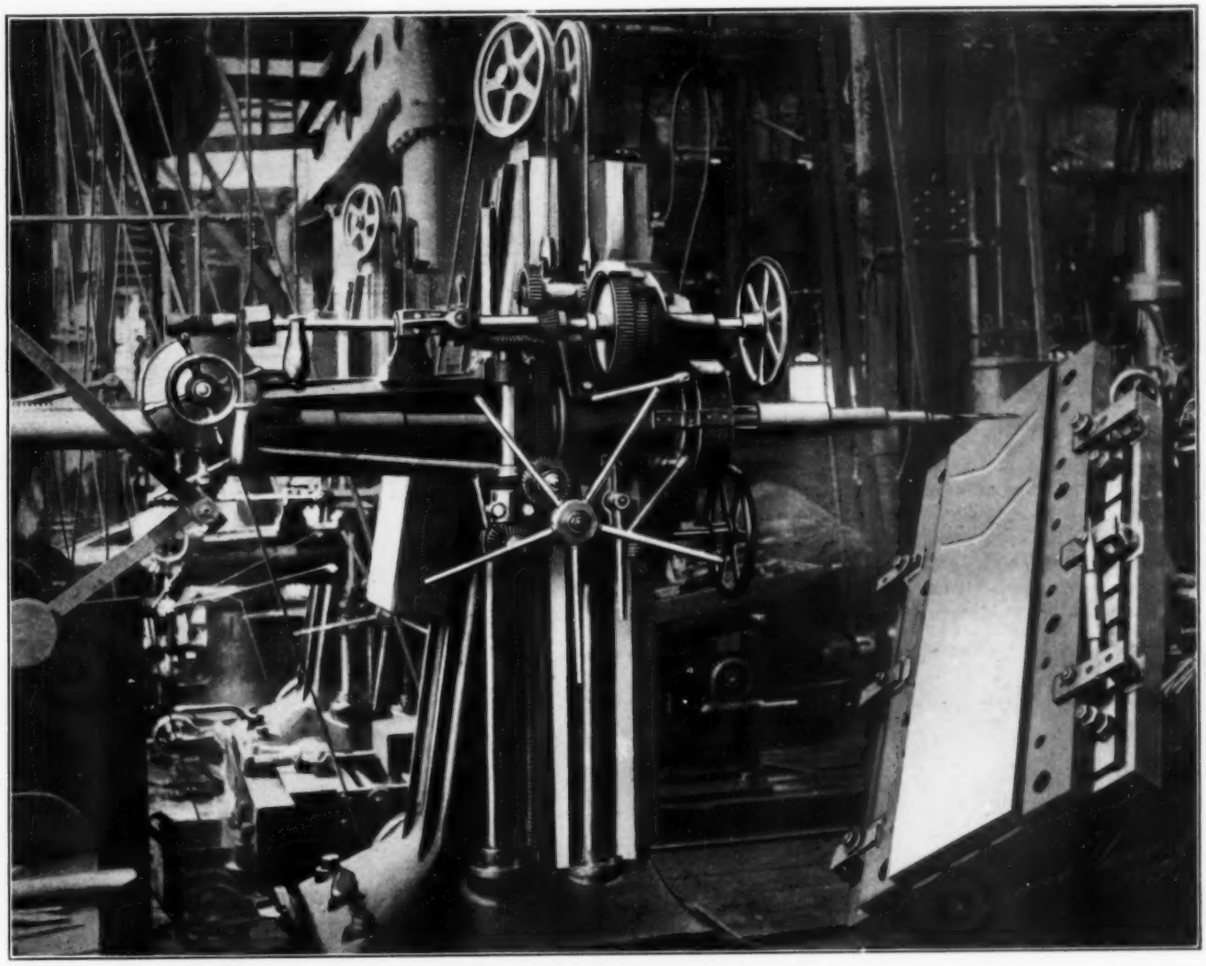


FIG. 9. DRILLING OIL HOLES IN CROSSHEAD GUIDES.

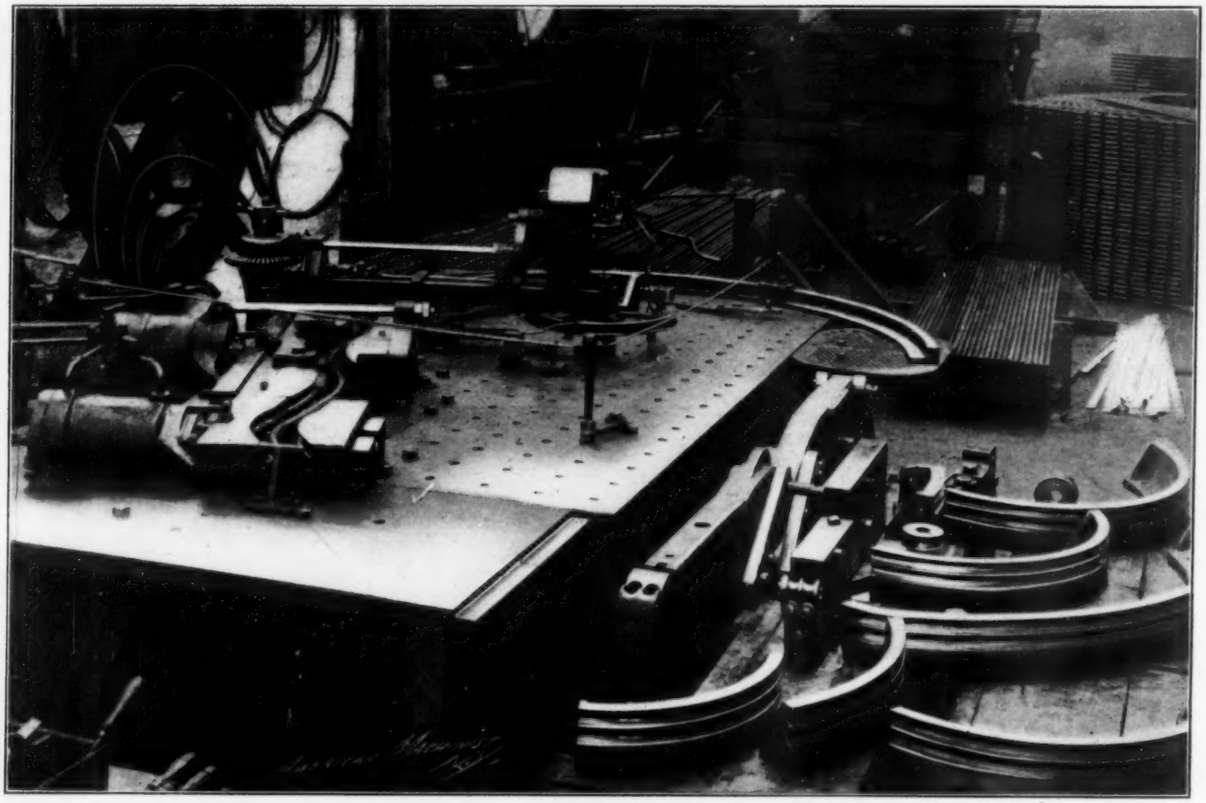


FIG. 10. PIPE BENDING MACHINE.

measures is, as an English writer on political economy of the eighteenth century pointed out, "A task which the greatest princes and the greatest politicians have projected and afterward abandoned. The difficulties are sufficient to render the speculator for the public welfare very diffident of success, unless he avails himself of two great political engines—namely, time and evident utility."

The total number of casualties to persons on the railways of the United States for the year ending June 30, 1904, was 94,201, of which 10,046 represented the number of persons killed and 84,155 the number injured. Of the persons killed 441 were passengers and the wounded 9,111, or one killed out of every 1,622,267 carried, and one injured out of every 78,523 carried.

FIG. 11. FORMS TO WHICH PIPES ARE BENT.

With the Mechanical Engineers at Liege.

BY JOSEPH G. HORNER, A. M. I. MECH. E.

A Saturday to Saturday was spent in Belgium by the writer, chiefly at Liège, with the Institution of Mechanical Engineers. The following remarks may be helpful to those who contemplate going over later in the season:

TRAVELING IN BELGIUM.

There are two routes to Belgium, one from Liverpool street, via Harwich, landing at Antwerp—a night voyage; the other via Dover and Ostend, a shorter sea passage, but a longer railway journey. Each place has its charms, Antwerp with its immense docks, and gay Ostend with its noble Digue, or promenade, and magnificent Kursaal. Here some of us spent the Sunday, going on to Liège early Monday morning. There is an excellent service of expresses, with comfortable corridor carriages in Belgium. The practice of burning briquettes produces much black dust. If you have to wait on a platform while an express passes through, give it a wide berth, or you will be covered up with smuts swept up in clouds by the rush of the train.

Belgium is rich in history and antiquities: Ghent, Bruges, Brussels, Louvain and other names are familiar to the student, and the system of tickets issued by the State railways for five, or fifteen, days at fixed prices enables tourists to travel all over the country, breaking journeys as they please, without troubling the booking offices. The country passed through between Ostend and Liège is as flat as a table for more than 100 miles, until the vicinity of the latter town is approached. It is subject to intensive culture; not a square yard is wasted, but spade cultivation and hand-watering make of the gardens beautiful little pictures. Hay crops are very heavy. Women work in the fields as well as about the collieries, at the level crossings and sweeping the streets of the cities. Their hard lives are reflected in their unlovely faces, particularly at Liège, the great industrial center. "They make everybody work there," said an American in one of our parties. "Even the dogs have to work." For dogs are much in evidence as beasts of burden. Most of the bakers' carts and many others are drawn by big strong dogs that rest under the carts when not dragging them along.

Around Liège the scenery changes, becoming hilly and, away from the mines and factories, magnificent, for Spa and the outskirts of the Ardennes are only a dozen miles away.

HOTEL ACCOMMODATIONS.

At Liège a real difficulty arises about accommodation. The hotels are full, and their charges are high. Fortunately, some of the party were provided with Cook's tickets, but there are only two hotels in Liège that take these, and they charge 2 fr. (50 cents) per day in addition to the tickets. One was full, the other gave us rather poor accommodation, which we were glad, however, to secure. Afterward I found that there were two or three good second-class hotels opposite the Guillemins station, but no English was spoken there.

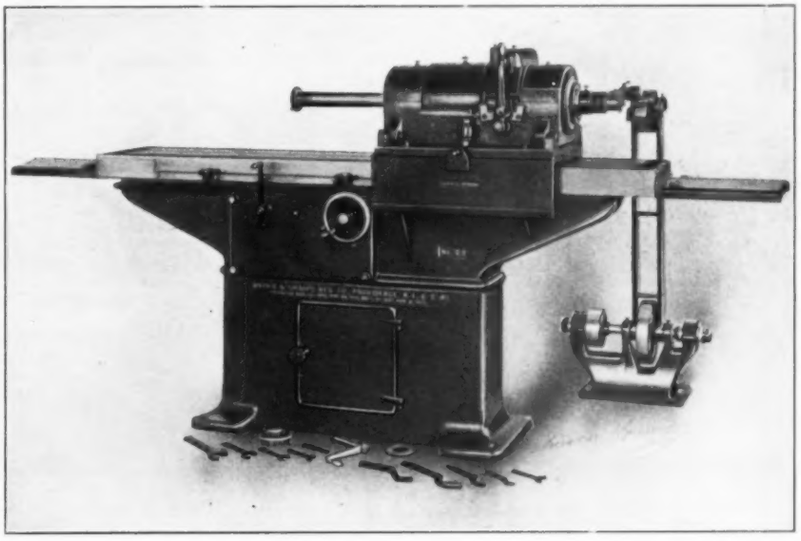


FIG. 1. CYLINDER GRINDER SHOWN AT THE LIEGE EXPOSITION BY THE BROWN & SHARPE MANUFACTURING COMPANY.

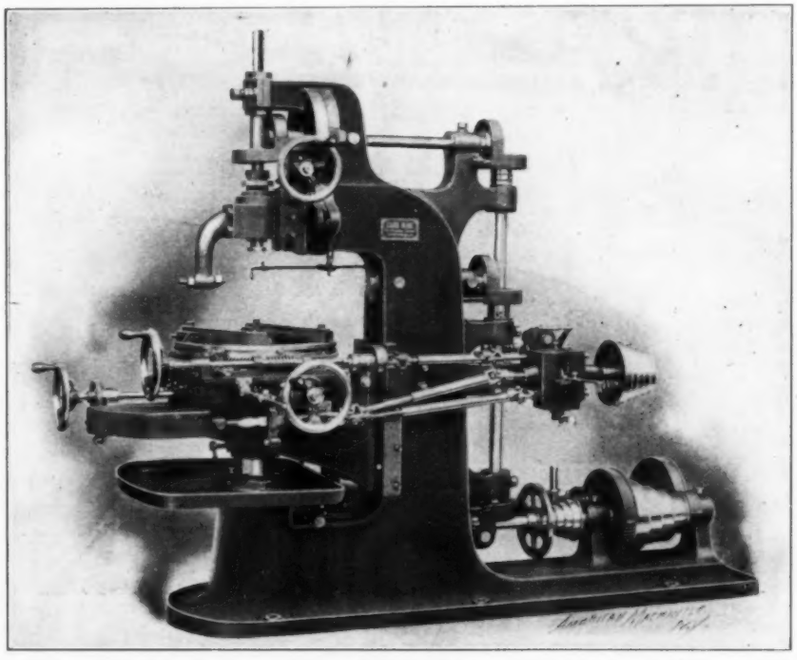


FIG. 2. UNIVERSAL DIE CUTTING AND MILLING MACHINE EXHIBITED BY CURD NUBE, OF OFFENBACH-ON-MAIN.

Belgium is interesting to the philologist from the fact that it includes two races, the Flemish and the Walloons, who remain in well-defined boundaries, east and west of Belgium, respectively, and those languages remain scarcely affected by the long employment of French, which is the language of Government, literature and the better classes. Flemish is closely allied to the Dutch. Neither language possesses any literature worth mentioning, and their use is confined mostly to the poorer classes. It is not unusual to meet people who know four languages well—French, Flemish, German and English.

THE CITY OF LIEGE.

Liège is the armory of Belgium, as it has been for centuries past. Much of the work is done by the workmen at their own homes, and about 40,000 men are engaged in this industry alone. It is a big city, with 164,000 inhabitants, picturesquely situated on both sides of the Meuse, and large portions are built on

sloping banks. The Ourthe flows through the city, and a considerable area is enclosed between this and the Meuse.

THE MACHINERY BUILDING AT THE EXPOSITION.

Liége is provided with an excellent service of electric trams, so that the exhibition can be reached quickly from almost anywhere for 10 centimes. Inside the grounds a light railway serves the entire circuit of the buildings, so that you can get to either of the buildings in a few minutes, for 10 centimes. The Machinery Building is included with a large group of miscellaneous subjects, easily located on a plan of the exhibition. It is worth a visit, but by comparison with the Paris Exhibition of 1900 is dwarfed. Many firms we expected to see are not there. The great French firms are mostly missing; few of the British are represented, many well-known German names are missing. All the machinery is under one roof: locomotives, gas engines, machine tools, boilers, iron, steel, copper, brass goods, but only making an exhibit that one can go through comfortably in a long day.

A MACHINE FOR GRINDING AUTOMOBILE CYLINDERS.

An interesting stand is that of Brown & Sharpe. It says much for the enterprise of this firm that they have a rather large number of machine tools so far from their base of operations. There is a new grinding machine here, Fig. 1, for the bores of cylinders of automobiles and that class of work. It is suitable not only for cylinders for petrol or gas engines, but also for doing internal grinding when the object cannot be rotated. The cylinder or other piece is mounted on a sliding table, through an intermediate jig, and is fed thus longitudinally, the length of travel —30 inches maximum—being controlled by adjustable dogs. The wheel spindle has provision for vertical and transverse adjustments, for alignment, and an eccentric movement, the whole being carried in a massive head. The wheel spindle is supported in a sleeve that gives support close to the wheel, and its front end is tapered to receive different grinding wheels. It is driven by a belt from the intermediate shaft seen on the floor, the belt being carried over the idler pulleys above, mounted on a swinging arm with tension adjustment.

The wheel spindle has coarse and fine adjustments. The machine will grind holes up to 7-inch bore by 14 inches long. It has three speeds of 5,249, 6,587 and 8,266 revolutions per minute. A pump provides a supply of water, which troughs and guards return to the settling tank.

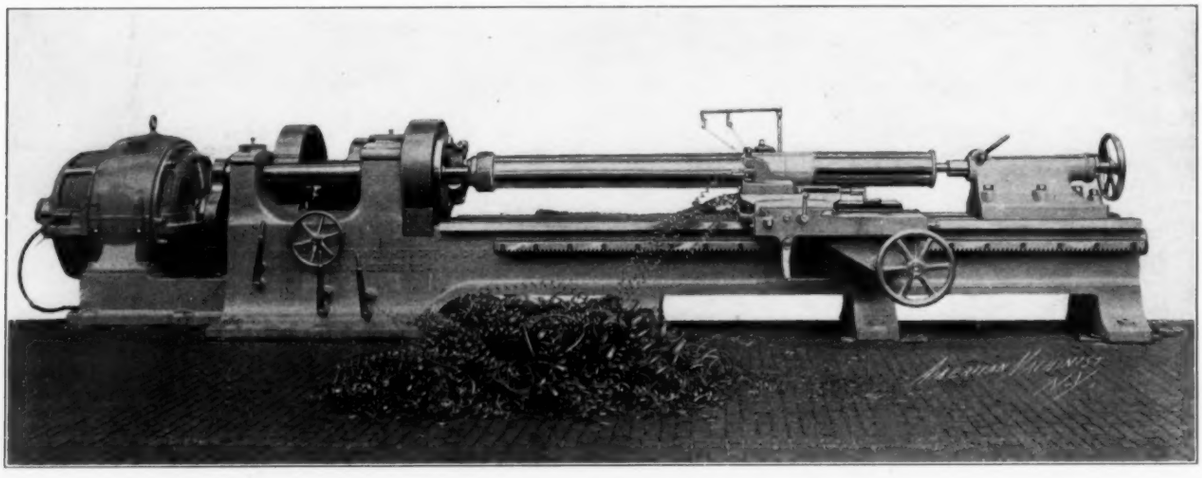


FIG. 3. 24-INCH HIGH-SPEED LATHE IN THE EXHIBIT OF SIR W. G. ARMSTRONG, WHITWORTH & CO., LTD.

The automatic bevel-gear machine, described in the AMERICAN MACHINIST, at page 145, Vol. 26, is also there—an interesting solution of the generating problem.

A GERMAN EXHIBIT OF GRINDERS.

Mayer & Schmidt, of Offenbach-on-Main, have one of the best exhibits. As most readers are aware, they are specialists in grinding machinery, of which they produce nearly every type, light and heavy, for common work and for high precision. Besides cylindrical and other grinders they have the following:

The demands made by motor-car builders are met by an automatic cylinder grinder which has its axis horizontally disposed. The cylinder, the bore of which is to be ground, is bolted on a table pro-

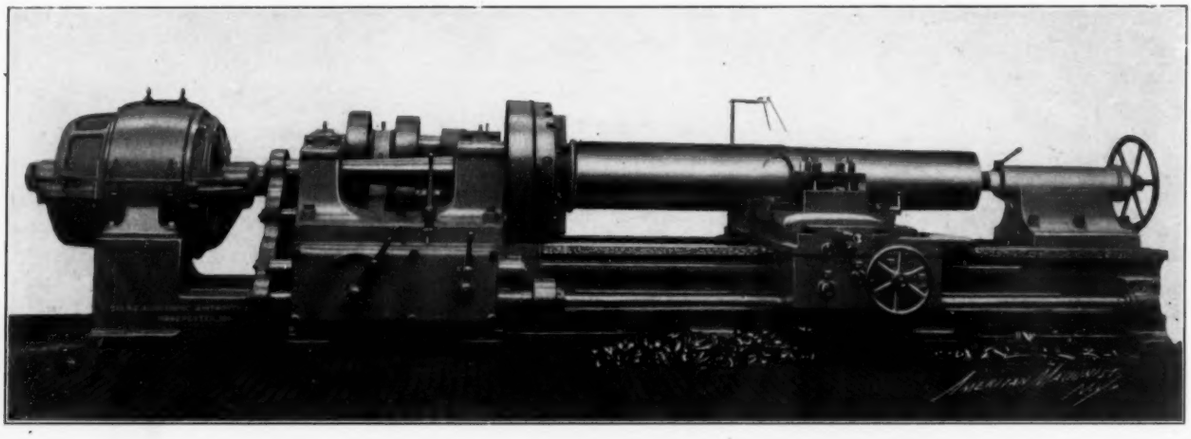


FIG. 4. 36-INCH HIGH-SPEED LATHE IN THE EXHIBIT OF SIR W. G. ARMSTRONG, WHITWORTH & CO., LTD.

vided with lateral adjustments. The emery wheel, carried at the end of a stiff tapering mandrel (snout style), has a double movement, rotatory and eccentric, and the latter can be regulated as the grinding proceeds. An automatic throw-out comes into operation when the required diameter is obtained. The longitudinal feed is imparted to the grinding wheel. The largest machine shown will deal with cylinders up to 300 millimeter bore and 1 meter in length. A link grinder, capable of dealing with curves up to 1,600 millimeter radius, also is shown. The radius bar to which the link is clamped lies vertically, and the axis of the grinding wheel lies horizontally. Straight links can be treated, and holes in bushings.

A very interesting machine here is the twist-drill grinder, the feature of which is that the drill rotates continuously, so that particles are removed from each lip successively until the grinding is complete, instead of finishing one lip and then setting for the other. Adjustments both for cutting angle and clearance can be effected while the machine is running. Surfacing grinders, cutter grinders and disk grinders are also shown. There are several common grinders as well (non-precision) to take the place of shop grindstones, and also saw-sharpening machines and belt polishers.

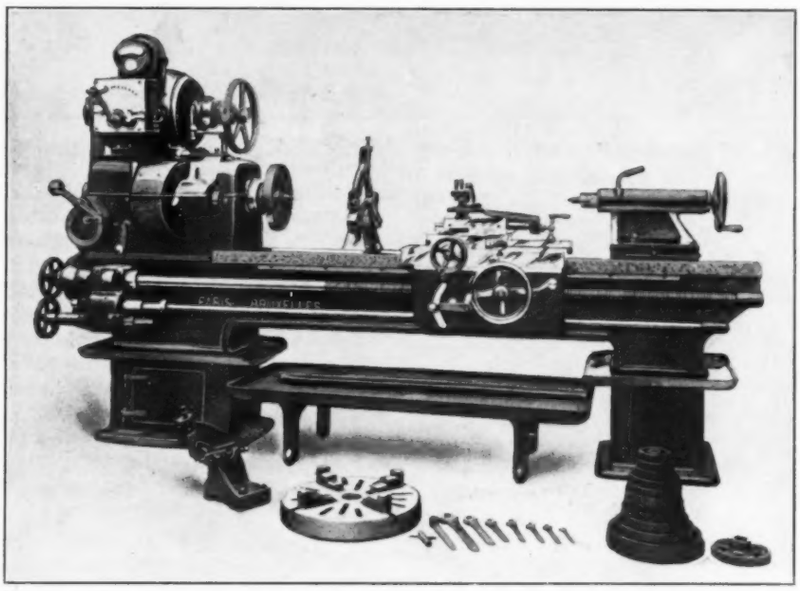


FIG. 5. LATHE SHOWN BY LE PROGRES-INDUSTRIAL SOCIETE ANONYME, OF BRUSSELS.

UNDERTYPE MILLERS.

Curd Nube, of Offenbach-on-Main, has an interesting exhibit of his undertype milling machines, the feature of which is that the cutter comes up from below, principally for convenience in die-cutting. This is the standard design, but it is varied by combining above in one frame two spindles, vertical and horizontal, the latter being provided with an arm support for long arbors. As the lower spindle has no vertical adjustment, the table is fed on a long cylindrical boss coming up from the base, and encircled by a boss coming down from the table base. In other types the table is carried, as in Fig. 2, on a knee, which slides on the face of the column. A useful feature is a swivel plate carrying the upper vertical spindle for angular milling, which in some form or other is embodied in most Continental machines.

The special machines for cutting dies generally have the lower spindle only, and a low independent stand. Numerous examples of dies are shown. The larger machines are nearly universal in their utilities, being employed for plain milling, drilling, boring and grinding. The cuttings fall away from the work and provision is made for lubrication.

HIGH-SPEED LATHES.

Sir W. G. Armstrong, Whitworth & Company, Limited, show high-speed lathes of 12-inch and 18-inch centers. The latter took a cut 1½ inches deep with ¼-inch traverse at 38 feet per minute. It is driven by a 60-horse-power variable speed motor, and is so speeded that it will turn up to 400 feet per minute on 20 inches diameter. These lathes are illustrated in Figs. 3 and 4.

Le Progrès Industrial, Société Anonyme, of Brussels, have several motor-driven lathes which present novel features, comprising ordinary and high-speed types. Fig. 5 shows one of these tools. In the larger sizes the carriages have double aprons to afford support to both ends of the gear spindles. The movements are engaged by clutches giving positive feeds, by which the slight risk of slip found in friction feeds is avoided. The lathes for high-speed work have steel gears.

HELICAL GEARING.

I noted some peculiar helical gears, of which, being unable to obtain photographs in time, I append tracings, Figs. 6 and 7, from the makers' illustrations. They are practically duplicated gears, and are cut, hence the rounding at the apex of the teeth. Messrs. Citroën, Hinstin & Cie., of Paris, are the manufacturers. At another stand the cut helical teeth were separated by a groove turned round the apex, presumably to facilitate cutting; but this must have a weakening effect.

BELGIAN GAP LATHE WITH ALL-GEARED HEAD.

The Ateliers Demoor, of Brussels, show some interesting lathes, including one with all-geared head, of which the photograph, Fig. 8, is here given. It is of the type with sliding bed. The height of the centers is 400 millimeters. The distance between centers (with the bed slid back to the extreme position), 3 meters. A five-stepped cone enables 15 speeds to be obtained, 5 by the steps, 5 by gears, and 5 by throwing in the face-plate crown gear. A Hendey-Norton type of gear box provides changes for screw cutting and feeding. Another interesting type of lathe is the one for turning mounted wheels, holding the axle journals in a collet-kind of chuck, so rendering one independent of centers in the axle ends.

WOOD-WORKING MACHINERY, METAL SAWS AND BOILERS.

A considerable amount of wood-working machinery is shown. Bandsaws for wood and for metal are much in evidence.

Of water-tube boilers there are plenty, evidencing the growth in favor of this type over the Lancashire.

There is one hampering regulation which the short-time visitor to the exhibition must take account of. The buildings are closed at 6 P. M., leaving the grounds only open. Thus I and several others were despoiled of several hours that might have been devoted to a study of machinery.

EXCURSION TO THE COCKERILL WORKS.

The visits and excursions of the mechanical engineers were numerous. It is always tantalizing to know that some dozens of interesting works are open to inspection at these gatherings, and that less than half a dozen can generally be taken at the time. The most interesting of all were the Cockerill works at Seraing, eight miles out of Liége, visited by river steamer or tram. When entering these works you feel as though you had gone back to the time of the Grand Monarque, for the offices occupy the ancient palace of the prince bishops of Liége, surrounding the Court of Honor, and the shareholders' meetings are held in the council-room of the states-general of the principality of Liége. They are surrounded by lovely grounds, colonnades of trees, greenhouses, flower beds and lawns.

CAPACITY OF THE WORKS.

The Cockerill works were established in 1817, and the first rails rolled and the first locomotive made on the Continent were done here in 1824. The boring machinery of the Mont Cenis tunnel was constructed

here, and the first bessemer converters used on the Continent were started in 1863. To-day the works occupy about 270 acres, and the firm's employees number nearly 10,000. They have 381 engines, developing 23,000 horse-power; a yearly output of 250,000 tons of coal, 122,000 tons of coke, 216,000 tons of pig, 157,000 tons of various steel products, and 39,000 tons of rolled sections, 6,900 tons of iron and steel castings, 1,600 tons of forgings, 8,900 tons of engines and guns, 8,600 tons of bridge and boiler work, and 4,000 tons of forged iron and steel products.

At Seraing everything is produced; coal and iron are mined, and the latter is smelted in the tall blast furnaces, made into steel in bessemer and in open-hearth furnaces, ingoted, rolled into bars, sections, tires and the rest, cast, machined and finished. In every shop there was something to admire. Everything was timed, and an itinerary given to each visitor; and as we passed through, metal was being teemed into ingots, ingots were being reduced to bars and rails, tires were being rolled, castings poured. In the foundries the most striking feature was the large dimensions of many of the pieces for the gas engines, and their freedom from faults. Large cylinders, involving

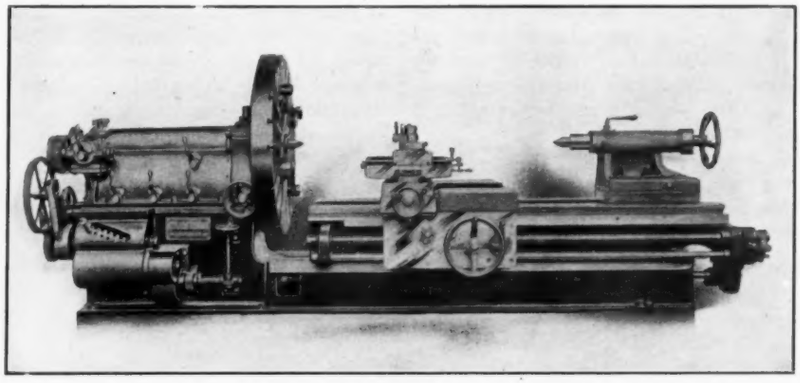


FIG. 8. SLIDING BED-GAP LATHE WITH ALL-GEAR HEAD, SHOWN BY THE ATELIERS DEMOOR, OF BRUSSELS.

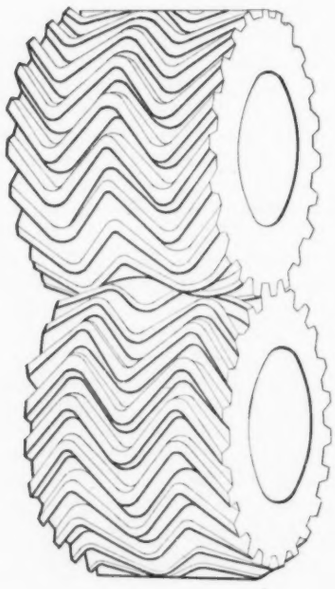


FIG. 6.

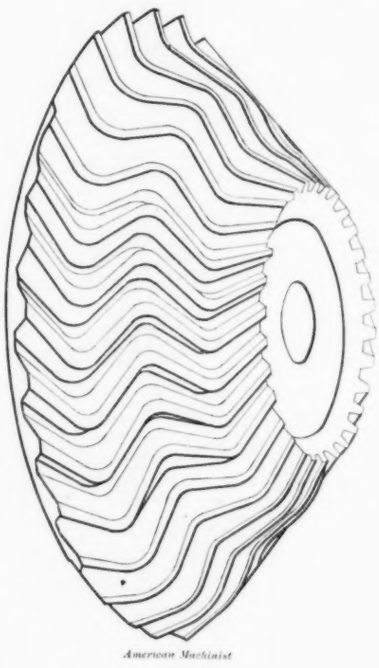


FIG. 7.

HELICAL GEARS IN THE EXHIBIT OF CITROEN, HINSTIN & CIE., OF PARIS.

several cores, were smooth, clean and sound. Of course loam work is much in evidence here. In the erecting shop the pieces look bigger than they do in the finished engines, partly due to the fact that all is leveled on blocking, while when erected some portions are down in pits.

GAS ENGINES USING BLAST-FURNACE GAS.

The firm is famous for several products, but at present great interest centers in the immense gas engines built for utilizing blast-furnace gas. We saw these both in the exhibition and in the firm's engine-house at Seraing. Figures are bald; to realize what a big modern gas engine involves, you must see it and try to grasp the details. One begins to wonder how much further the practice of engineering is going to develop, and to feel that the next generation must, more than the present, be one of specialists.

As far back as 1894 the Cockerill Company made its first experiments on engines driven by blast-furnace gas. Since then great advances have been made, the results of which are now seen. This firm, and those working under license therefrom, have built 148 gas engines, of a total of 102,925 horse-power; 45 per cent. are employed for electrical purposes, 52 per cent. for blast-furnace blowers, 2 per cent. for rolling mills, and 1 per cent. for general purposes.

FEATURES OF DIFFERENT DEPARTMENTS.

In the erecting shop, consisting of three bays where the biggest engines are built, there is a large floor bedplate, planed to receive heavy castings to be machined. A boring mill on this has two movable heads, capable of taking 24½ feet between them. The work being fixed, the machines are manipulated around it. The bedplate has an area of 1,620 square feet.

The locomotive shop at the Cockerill works is capable of turning out 100 locomotives in a year; it is served by 40-ton electric traveling cranes. Steam hammers predominate in the forging department; there is but one press, of 2,000 tons power. The biggest hammer is 30 tons, with a stroke of 10 feet.

The blast furnaces are supplied by nine blowing engines, six being steam driven, and three by blast-furnace gas. New furnaces are replacing the older ones. They are 79 feet high, with a daily output of 250 tons.

Thirty-five locomotives serve these works, on a network of railways totaling to forty-seven miles in length, of standard gage. There are 529 trucks, a steam tug and eight barges. The company looks after the welfare of its employees, having elementary schools at Seraing, a miners' school and a naval school at Hoboken. Five physicians call daily at the factory, and at the homes of the workpeople, and a hospital is provided with 230 beds.

A VISIT TO A GEAR-CUTTING SHOP.

From the Cockerill works some of us took in the Ateliers de Malzine, a little shop at Sclessin, where gear cutting alone is done, with the most modern machines, using rotary cutters, planer and generating tools. Every machine of note was here, including the Bilgram, the Gleason and the Fellows. The smaller blanks are mostly sawn from the steel bar, and turned with high-speed tools. A little toolroom is provided where the cutters are made and kept in order.

I could not find time to go to the National Small-Arms Factory at Herstal,

which was a matter for regret, as I heard that it was a most interesting and well-equipped establishment, the strong feature being the large place occupied by jigs and special cutters and small tools. Everything is simplified, and the result is that a large number of the machines are attended to by women, and much of the gaging is done by them. The limits of tolerance vary between 0.004 and 0.002 inch. The number of workpeople varies from 1,500 to 2,000.

A BELGIAN RESERVOIR.

On Thursday many of us went to Spa by train, thence in open carriages to the Barrage de la Gileppe, amid lovely hilly wooded scenery. This immense barrage crosses the valley of the Gileppe, and was built to impound the waters that come down from the surrounding hills and regulate their supply to the town of Verviers, a few miles away. The water is very pure and suitable for the cloth industry of Verviers, and also for drinking purposes. The curious feature of the barrage is that it is not pierced with openings for regulating the supply, but the latter is brought around it on both flanks of the dam. The engineers had to adopt this course in deference to local prejudices, people fearing that the dam would be unsafe if not solid. Its leading dimensions are: 90 yards long by 72 yards thick at the base, and 256 yards long by 16 yards thick at the top. The parapet is 154 feet high, the normal level of the reservoir being 148 feet. The area is 200 acres, and the capacity 2,700 million gallons. A huge lion surmounts the embankment, looking down the valley. It is constructed of 187 sandstone blocks.

Here the Ardennes, so much beloved by tourists, commence. Words would fail to describe the magnificence of the tree-clad slopes here, and we regretfully drive back to the stony streets of Liége.

THE ANTWERP DOCKS.

On Friday we went to Antwerp in a special train, lunching *en route*. Carriages there drove us round the docks, which, though vast, are insufficient for the growing trade of the port. New docks are in course of construction, which, when completed, will total to seven miles in length. A curious thing, so it seemed, is that bricks are used in preference to concrete for the dock walls. The gentleman who was our cicerone said that brickwork came cheaper there than concrete, for their men would lay 4,000 bricks a day.

Bath, England.

Discussing the teaching of mathematics to engineering students, *Engineering News* remarks: "As there are two kinds of physical training, so there are two kinds of mental training. A man may build up his muscles by exercise in a gymnasium or by chopping wood, but, if he expects to earn his living by wood chopping, he had better engage in chopping at once rather than in pushing dumb-bells."

Some College Shop Experience—III.

The college power plant was located at the foot of the cliffs, about 100 feet below the shops, so as to be on a level with the railroad track which supplied fuel. The plant was manned mainly by students who were working their way through college. The "Prof" had nothing to do with the plant, except as he was called in to repair breakdowns. The two firemen were burly young specimens who had made a little money in some of the mines—enough to start them at college—and were doing work to help pay their way through. The engineer had been hoisting engineer in one of the mines, and his assistant had run a threshing machine for several seasons. The "Prof" used to pass through the plant frequently in going to and from his meals, on account of the fact that the steps down the face of the cliff to the upper floor of the power plant afforded him a short cut.

Upon entering the plant one day he heard some excited voices coming from the lower, or boiler-house, floor. From where he stood in the upper room he commanded a view of the condenser-room and boiler-house. None of those at work below knew that he was in the building. The force consisted of Black Mac and Cousin Jack, the firemen, and Red Frank, the former hoisting engineer, and Farmer Bill, the threshing expert. The quartet was presided over by His Nibs, appropriately decked out in white collar, cuffs and a silk hat. The trouble was evidently something about the condenser, and the conversation was continued by Black Mac: "If we can't have water pretty quick we will have to shut the boilers down." Red Frank said, "We ought to start the engines in an hour." "I can't make that condenser go; there must be a leak in the suction somewhere," from another. His Nibs then said, "We will take it down and repack it," and he proceeded to give orders and direct the work in detail.

The offending piece of mechanism was a Wheeler condenser, which had to raise water about 15 feet from the well, and at the elevation in the mountains at which the plant was situated this is quite a serious problem and requires a tight suction. In order to economize pipe, the boiler-feed pump and condenser had both been attached to the same suction pipe from the well. For fear that the leak was coming from the boiler-feed pump it had been disconnected and a blank flange bolted over the face of the T where it was ordinarily attached. The boiler-feed pump had been arranged to take its supply from the cooling water from the condenser, but, as mentioned, the condenser was not running, and the situation was becoming grave.

Among the first orders on the part of the officious gentleman in charge was the demand for four monkey wrenches. When they were procured he set all hands to work taking off the head from the steam end of the condenser. Red Frank remonstrated and said that anything that was wrong with the steam end could not affect the circulating pump. "Go along! You don't understand steam engineering," was the prompt rejoinder which he received; "there's a connection inside, and I will show you how to find the leak." This series of remarks proceeded from His Nibs. The result was that the boys, doing all the work, patiently disconnected and examined every part of the steam end of the condenser. They then turned their attention to the water end, and had to take everything above the circulating pump off that they could get off.

The well was out of sight when they were working at the condenser, and in his excitement our officious friend did not notice that Black Mac and Cousin Jack, the firemen, had absented themselves. In the course of a few moments they returned and proceeded to open a valve in a 1-inch pipe, which was used for priming the circulating pump. This valve brought water from a reservoir on the hill, at about 150 pounds pressure. Before the valve had been opened many minutes one of the joints was blowing water in a stream about as big as a knitting-needle.

What had happened was this: the two firemen, making an excuse that they must see to their boilers, as an explanation for their absence, succeeded in slipping a block with a piece of rubber packing tacked on to it under the end of the suction pipe in the well; and then by rigging some wires and levers they clamped the block tight against the bottom of the suction pipe. When the water was introduced into the pump cylinder, sufficient of it leaked past the suction valves to show up the leak in the suction. The man in charges stepped around in time to get a spray from the leak across his clean cuffs, and was immediately informed by Black Mac and Cousin Jack that they had found the leak.

As it was getting dark and the plant must start in a few minutes, His Nibs discovered he had an engagement with the president, gave the boys orders to reassemble the parts of the condenser and started up the stairs. The "Prof" discreetly started down and met His Nibs on the way up. He was greeted with, "Do you know, those fool boys have been trying for two hours to get that condenser started and I just came in and found the leak for them and showed them how to put it together again," and with these remarks he pushed on up the stairs. As quick as the upper door of the engine-room was heard to close, there was an exposion of laughter in the condenser-room, and when the "Prof" entered the four denizens of that region were doubled up with laughter.

As the "Prof" was considered a safe party to impart a joke to, he was let into the secret. The boys had tried to start up the plant and found that there was evidently a leak in the condenser suction.

Just at that moment they sighted His Nibs coming up the railroad track and a hasty consultation resulted in the decision to refer the matter to him and have a little fun at his expense. The fun was just commencing when the "Prof" blew in above, as has been already related. In ten minutes everything was going well. His Nibs had never been informed that the boilers could be fed at any time, and, in fact, were fed during his presence by water direct from the high-pressure reservoir. This was always available on account of the fact that they never carried over 130 pounds of steam at the plant while the reservoir gave a pressure of 150 pounds; But His Nibs never knew what a cruel joke had been played on him, and probably believes to this day that the steam end of a Wheeler condenser has a secret passage leading to the suction.

It is said that twelve thousand freight cars, all in good, serviceable condition, are to be reduced to junk or sold to small local railroads by the Pennsylvania Railroad Company; and the reason is that they are not of the latest pattern, but the old well-known wooden affairs. They are to be replaced with cars of modern design and steel construction.

The new German tariff schedule, which is expected to so greatly affect the American export trade, has just been published in convenient form by the Department of Commerce and Labor, Washington, D. C.

Large Thread-Milling Machine.

At page 1629, Vol. 25, we illustrated the thread-milling machine built by the Pratt & Whitney Company, and we now show a much heavier machine of the same type, which they have designed especially for cutting large worms, hobs, etc., it taking work up to 12 inches diameter and 48 inches in length. The general proportions of the machine and most of its important features are well brought out in Figs. 1 to 5 inclusive, and two interesting specimens of work produced are shown in Figs. 6 and 7.

The headstock and footstock rest on a "V" at the back and a flat way in front; the carriage travels on flat ways at front and rear. It is gibbed in a narrow angular slide at the rear, and through the center of which the lead screw passes, and lifting of the carriage under the action of the cutter is prevented by a gib underneath the flat way in front. The hollow spindle is provided with draw-in collets to grip the shank of the work, or the arbor upon which the work may be driven, and after the handwheel at the rear end is tightened the grip is still further increased by a powerful lever acting against a shoulder on the drawing-in tube, which lever is forced back by means of a screw (shown at *A*, Fig. 3). This device is clearly shown also in the rear view in Fig. 2.

As will be seen from the general views, the drive for work, cutter and lead screw is by means of a three-step cone pulley at the upper end of the bed. This, in connection with a two-speed countershaft, gives the cutter spindle six rates of speed, ranging from 31 to 65 turns per minute; while through the medium of a gear box, whose mechanism is controlled by a pair of handles, twenty-four rates of rotation in either direction are obtained for the work spindle to each speed of the driving shaft. Change gears of course connect spindle and lead screw to give the cutter carriage any desired rate of feed per turn of spindle, and automatic stops release the carriage feed in either direction at any desired point.

The gear box and the gearing leading up to the spindle will be noticed in Fig. 2; the two handles which control sliding keys in the gear cones being shown just to the left of the driving pulley. The double worm shaft mounted on the gear box and passing crosswise under the head engages with a worm wheel on the back shaft above, which is geared to the spindle and also engages with a worm below, which is connected with the lead screw. Both worm wheels are furnished with clutches controlled by levers at the front of the head, and an interlocking device makes it impossible for the two worm gears to be clutched to their respective shafts at the same time. Ordinarily, then, the drive for the work and for the lead screw is from the gear box, up through the worm shaft and back-gear shaft to the spindle and then down through the train of change gears to the lead screw. For very quick leads, however,

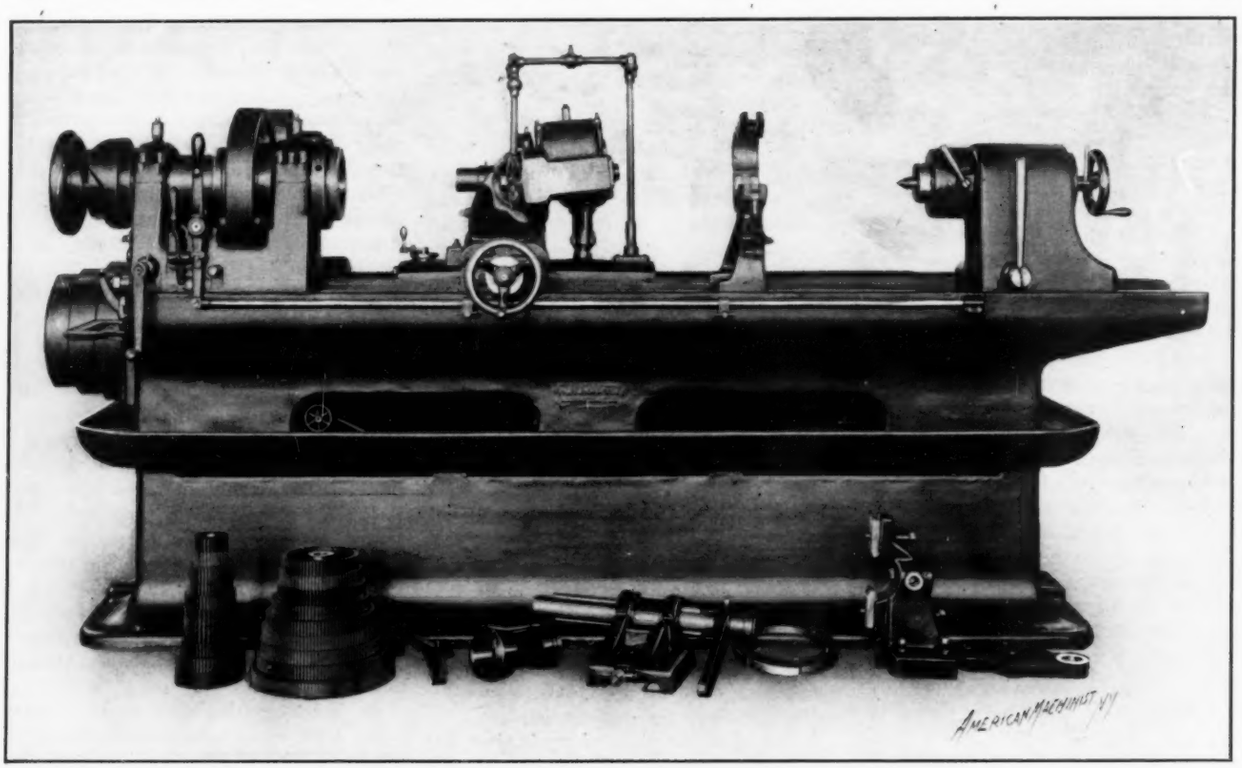


FIG. 1. 12X48-INCH THREAD MILLER—FRONT VIEW.

where the movement of the screw is necessarily much faster than that of the work, the drive is first from the gear box and worm shaft to the worm connected with the lead screw, and then from the screw, up through the change gears to the spindle. The rate at which the latter rotates may be varied (in geometrical progression) through the counter, cone pulley and gear box from one turn in 26 minutes to one turn in 1.2 minutes.

The small pulley at the rear of the head in Fig. 2 is for the quick return of the carriage, the clutch for the spur gears driven by this pulley being so designed that it can be thrown into action only when the regular worm-gear drive is disengaged. The carriage and cutter head are brought out a little more clearly in Fig. 5. The connection between the driving shaft at the rear of the bed and the cutter arbor (which is hardened and ground) is thru the medium of bevel and spur gearing, the ratio between driving and cutter shafts being about 10 to 1. The gearing is stiffly supported in all cases, and enclosed; and the telescopic connection between the driving shaft and the gearing mounted on the carriage is rigidly braced by a steel guide bar behind the vertical shaft. The cutter spindle is reversed for left-hand threads by shifting a small handle at the top of the cutter head, which handle controls a clutch between a pair of bevel reversing gears.

The swiveling cutter head is so mounted on the carriage that the point of the cutting tooth is always at the same hight as the center of the work, no matter at what angle the cutter spindle may be tilted. Graduations are provided on one of the head trunnions to give the correct settings for the helix angle and the head is easily adjusted by a crank-operated worm and worm-wheel. A nut with pinholes for a spanner is fitted as shown to the front trunnion and clamps the cutter head firmly after it is set. The carriage may be moved along the bed by turning a handle at the front of the headstock (thus actuating the lead screw) and its position may be very nicely adjusted by means of a small handle shown in Fig. 5 just above the feed nut, this handle serving to rotate the nut upon the screw. For setting the cutter to the precise depth in the work, the cross-feed screw carries an adjustable micrometer dial which is set at zero when the cutter tooth just touches the outside of the work. The carriage is then run back to clear the cutter from the piece and the cutter brought forward by the micrometer cross-feed screw to the correct depth.

For multiple threading and spiral gear cutting an indexing ring is provided as shown in Fig. 4. This ring is attached to a sleeve on the spindle and connected with the driving gear by a pawl which may be lifted by means of a latch operated from the other side of the gear. This indexing pawl is seated firmly between two steel abutments secured to the gear, and, when dropped into place, locks the spindle positively against any motion relative to the gear.

The machine is equipped with an attachment for relieving hobs and this device is shown in Fig. 1 at the front of the base. It consists of a rockshaft which is mounted in a bracket fitting the cross-slide guide on the carriage, and has an arm at one end to engage with a cam attached to the collar on the nose of the hollow spindle, the cam teeth corresponding in number to the rows of teeth on the hob. At the center of the rockshaft is keyed an arm which engages with the flange on the outer support for the cross-feed screw, this support being disconnected from the carriage when the attachment is put on. As the cam and work rotate together the rockshaft draws the milling cutter forward until the rear of the hob tooth is reached, when, upon the cam clearing the rockshaft arm the cutter is forced back to its original position ready for relieving the next tooth, by a

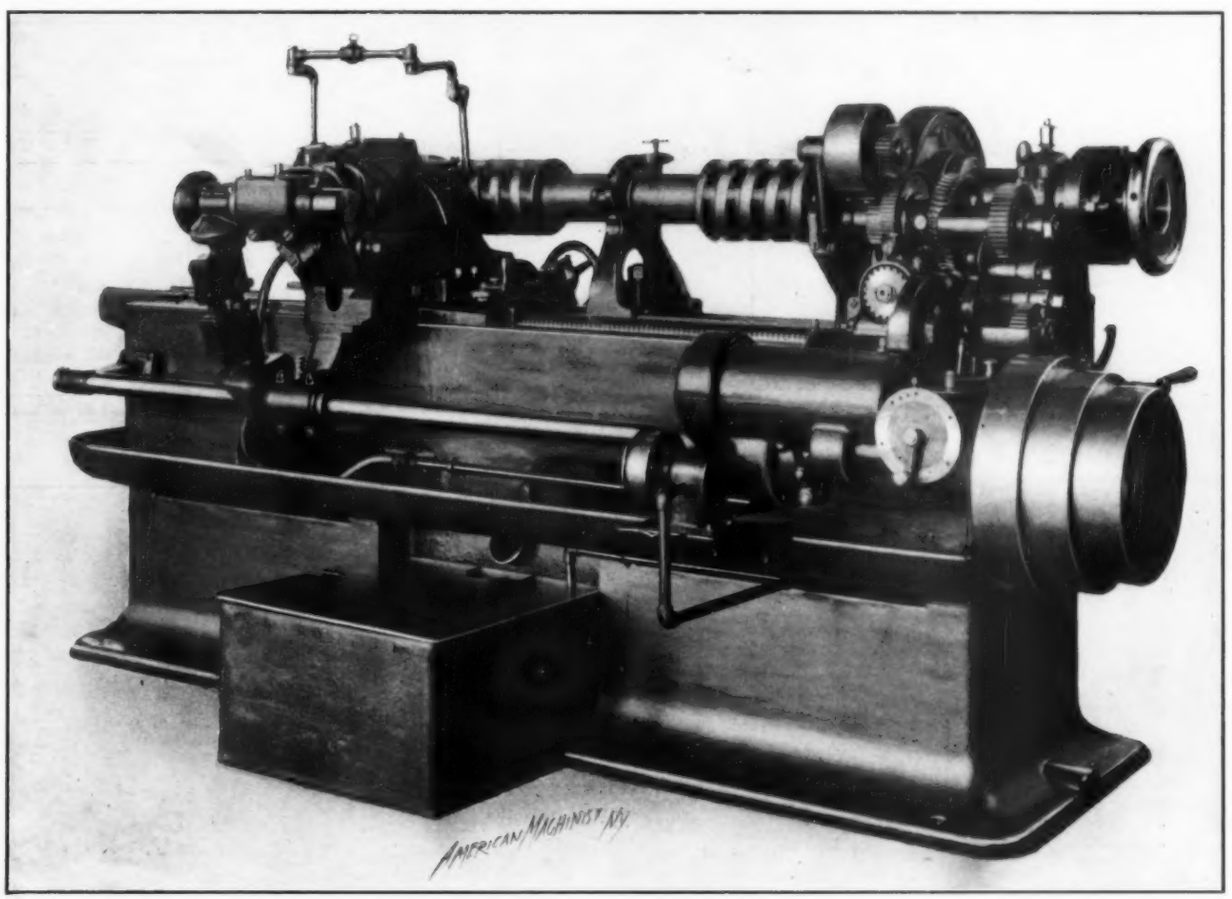


FIG. 2. 12X48-INCH THREAD MILLER—REAR VIEW.

spring plunger seated in the attachment and pressing against the front of the cutter slide.

Some idea of the character of the work which the machine will handle is given in Figs. 6 and 7, the first of these showing a double-worm shaft, made from a tough steel forging about 5½ feet long over all, and measuring along the helix 97 inches—was taken in 1¼ hours, the machine taking the cut easily and producing a very smooth surface. This same piece is shown in position in the machine in Fig. 2 with the cutter operating in the right-hand thread. The shaft is shown supported at the middle in a steady-rest while the outer barrel driller and the shell was then driven on an arbor and milled to form the spring. Two cuts were taken, the total time being approximately 10 hours.

As indicated in several views, ample provision is made for keeping work and cutter cool, all cuts on this machine being taken under a flood of liquid. The hol-

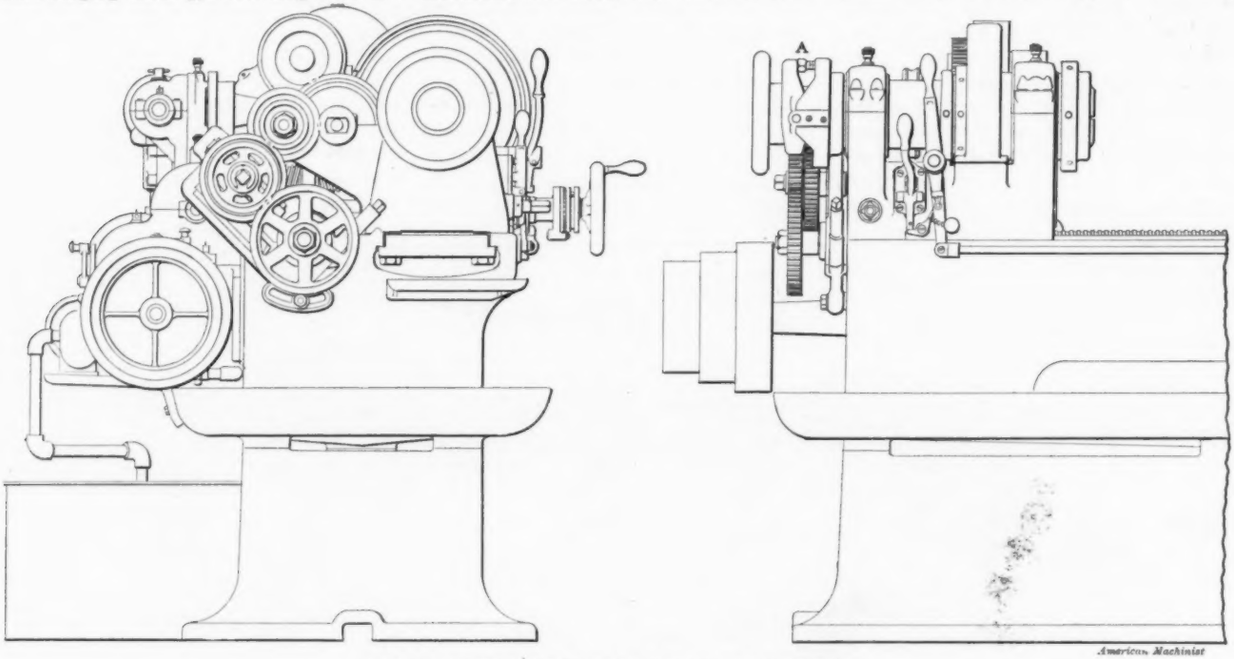


FIG. 3. ELEVATIONS OF HEAD END OF THREAD MILLER.

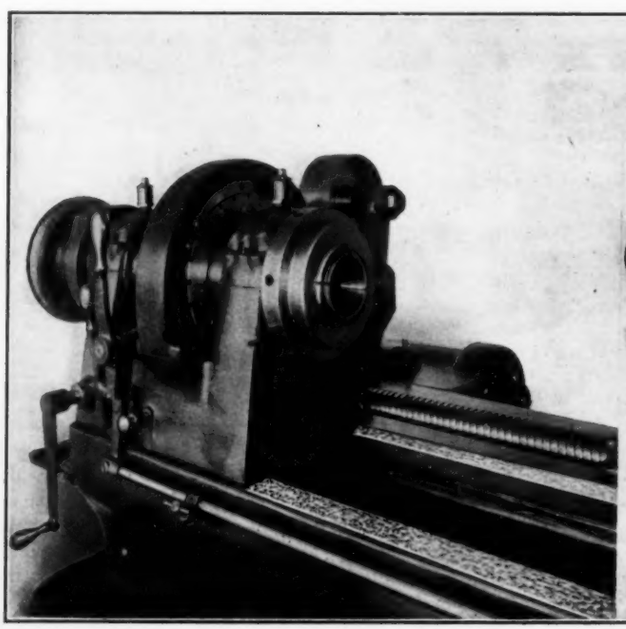


FIG. 4. THE HEADSTOCK.

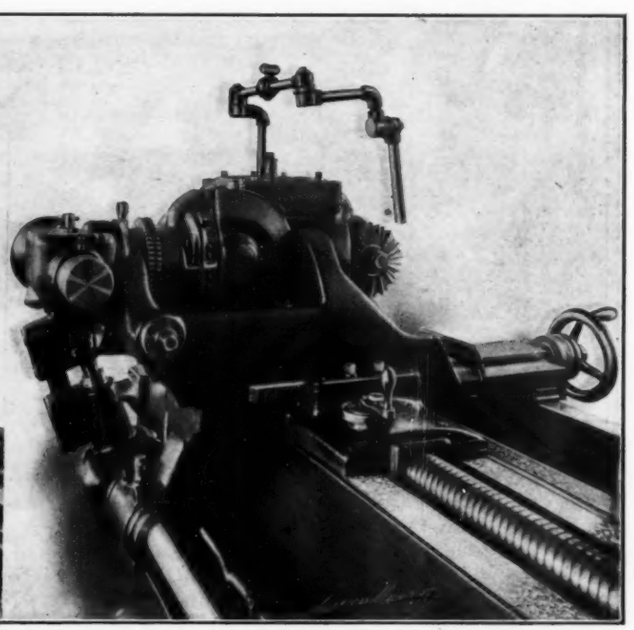


FIG. 5. THE CARRIAGE AND CUTTER HEAD.

the threaded portion being 7¼ inches diameter by 10½ inches long, with a lead of 2½ inches, and a depth of thread of about 1⅜ inches. Two cuts were taken in the thread, about ¼ inch on a side being left for the second cut. A 5-inch cutter running at 36 turns per minute was used, and the first cut—over an inch in depth end runs in a bushing slipped into the footstock.

The spring in Fig. 7 (a special job recently handled on this thread miller) is 10x24 inches and was cut from an oil-tempered steel forging which had to be annealed before it could be chucked out. The boring was done on a gun-

low spindle in the head has a 3¾-inch hole through the drawing-in tube and maximum collet capacity of 3½ inches, and the spindle bearings are 6¼x4 and 5¾x3½ inches. The three-step driving cone takes a 3-inch belt and its largest step is 16 inches diameter. The two speeds of countershaft are 320 and 440 turns per minute.

Duane Herbert Church.

The following particulars regarding Duane H. Church, who died at West Newton, Mass., August 1, and at the time of his death was superintendent of the American Watch factory and one of the best known inventors of watch-tool machinery, etc., in this country, form part of an interesting account of his career which appears in the *American Jeweler*.

Duane H. Church was born in Madison county, New York State, in 1849, and at the age of sixteen began his apprenticeship as a watchmaker under the instruction of J. E. Gridley, of St. Paul, Minnesota. After completing his work under Gridley's instruction, Mr. Church worked for seventeen years as a watchmaker at the bench, principally for Matson & Co., of Chicago, and for St. Paul establishments. In 1882 he attracted the attention of the Waltham company, and entered its service, first traveling one month on the road in "missionary" effort, asserting machine-made watches to be superior to all others—a proposition much more nearly true now than it was then. Next he was for another month in the Boston office of the company on experimental work, and finally reached the factory and at once took the position of master watchmaker, which he held for eight years, during which he greatly improved the general design of the watch movements and devised the form of pendant setting watch which enables stem-winding movements to be placed in cases not specially fitted to them —the most valuable feature, commercially, ever applied to watch construction.

After twenty-five years of intimate association with watchmaking in all of its forms, Mr. Church began advancing the use of Maudslay's slide rest and Stone's turret to what is now by far the most exalted plane of development known, and giving those elements powers which appear impossible of further advancement, these tools being fully automatic, and in all instances completing the piece produced before letting it go, no matter how many or how complicated the operations to be performed.

Mr. Church added to the slide rest and turret two new elements—first, that of compressed-air-driven piston-and-cylinder actuation of his automatic-machine members, and, second, a perfectly exact series of transfer elements, having the power to take a piece of work from one machine and place it accurately in another machine, with a beauty of action and precision of effect which seem very little short of the miraculous.

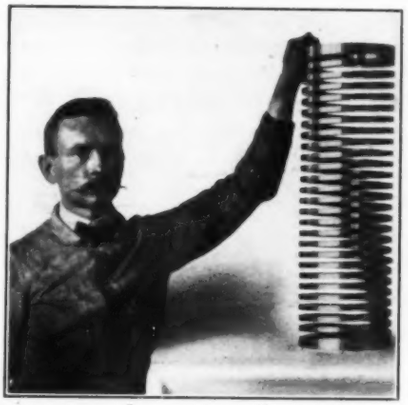


FIG. 7. A LARGE SPRING CUT IN THREAD MILLER.

When Mr. Church took the position of superintendent of toolmakers at the Waltham factory, the theory of step-by-step production was in force. There were roughing cuts and finishing cuts on the same piece, made in different machines and involving separate handlings. Mr. Church had become fully convinced that the cheapest and best method of machine-part finishing was formulated in Gridley's admonition, "Never leave a piece of work until the best possible effect has been gained"—that is to say, once a piece is in the grasp of an automatic machine it should not be released until fully completed. In the ten years during which he has been in charge of the Waltham toolmaking he has succeeded in carrying out his conception of complete production with only one handling in the making of many of the watch parts, the plate-drilling machines being the most impressive of all of his creations, because they are the largest, and the superlative accuracy of their transfer movements is plainly observable. When he took the plate-drilling in hand it was done through jigs handled by girls, each girl having a drilling machine with three vertical spindles carried in one head, each spindle rotating a different tool, and having an independent feed motion. Each girl drilled in a watch plate all the holes of the sizes produced by the three drill spindles of her machine; then the plate was taken out of the jig and passed on to the next operator, who placed it in another jig and went on to drill the holes of the sizes produced on the machine under her charge. In spite of the utmost care possible this step-by-step production produced imperfect plate drilling and made trouble without end.

Mr. Church had a clear conviction that there should be no jig work, which means that all holes must be located by the axis of rotation of the drill spindle, the drill itself having no surrounding exterior guiding surface, and hence that, for each hole, the plate must be brought to exact position in relation to the drill-spindle axis; if the plate could be held, say, horizontally over a rising drill spindle or cutter spindle, then the desired operation could be properly located in the plate. There are about one hundred and sixty different operations to be performed on a full plate; each vertical spindle head could conveniently carry as many as six spindles and it was clearly possible to place as many heads, each carrying six tool spindles, as were needful, on one long frame, and provide each of the six-spindle vertical heads with overhead plate holders, and to transfer the watch plates from one plate holder to another, successively, each plate holder correctly locating the plate over some spindle carried in one of the revolving spindle heads. It was also clearly possible to begin operations on the watch plates by supplying them in filled delivery magazines to the drilling machines, so that the transfer arm and hand could take a plate from the magazine and place it

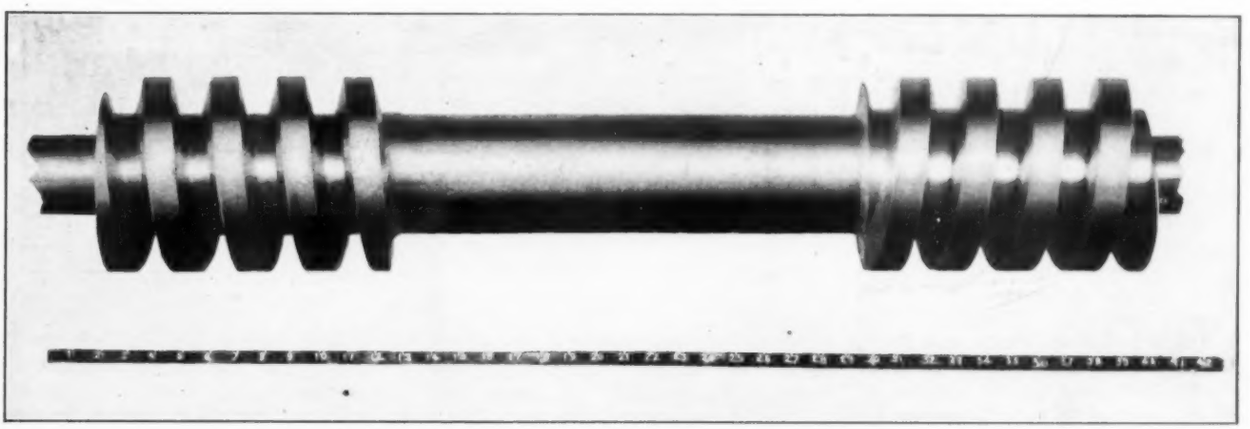


FIG. 6. DOUBLE WORM SHAFT CUT IN THREAD MILLER.

in the first horizontal plate holder, and from this first plate holder another transfer arm and hand could take the partly completed plate and deliver it to the next plate-holder in sequence, until, at last, the final delivery arm and hand should place the completely drilled plate in a receiving magazine, located at the end of the machine farthest from the delivery magazine through which the plates are given to the machine.

Here, then, was a clear, clean-cut, general scheme of plate drilling—which was, however, wholly impossible of construction with any details then known in toolmaking. The horizontal plate holder could be mounted on two of Maudslay's slides, one carried by the other, and these slides could be so moved as to bring any point in the plate over the axis of the tool-carrying spindle below—but how?

The answer Mr. Church made to this apparently unanswerable question was wonderfully simple, wonderfully suitable.

It was wholly impossible to produce the double motion of the plate carriers by means of cams and levers, for two reasons: First, want of possible accuracy, and, second, want of room. It was impossible to place the required number of cams and levers in their proper relation to the plate holders and spindles, and cams and levers being the only means known for operating automatic tool members, it was clearly impossible to construct this ideally perfect plate-drilling machine. The requirement was some device which would move two comparatively heavy slides, quickly and certainly, to a position absolutely certain with relation to a fixed point which employed no mechanism, and was not subject to wear of any description. Could absurdity of mechanical demand go further?

Yet these impossible conditions were met in the easiest manner possible by the use of compressed-air pistons and cylinders, applied directly to the moving parts, so that, whenever air pressure was admitted to a cylinder, the piston instantly drove the connected member to a flat contact stop of hardened steel, the rapidity of traverse and intensity of the contact blow being perfectly controlled by the air-admission cocks, which are cam-operated. With this beautifully simple and perfect machinery Mr. Church moved his plate-holding slides with positive accuracy, revolving heads of hard-steel stop pins giving each hole location in the plate an adjustable definition which can be individually regulated to any degree of precision desirable, with the practical result of producing watch plates with no measurable or discoverable variation in the location of the holes.

The largest plate-drilling machines have a delivering and receiving magazine, six plate holders, six spindle heads carrying six spindles each, making thirty-six live spindles in all, and seven transfer arms and hands.

2½- and 3-Foot Radial Drill.

The accompanying illustrations represent a drilling machine having a capacity for drilling from the solid rated at 2 inches for steel and 2½ inches for gray iron. Of new design throughout, the tool contains many improvements over its predecessors, but its chief characteristic lies in the speed box, which, without the back gears or a clutch of any kind, gives instantly, with a single lever, six changes of speed.

Referring to the diagram, it will be seen that the speeds are obtained by means of a primary shaft *C* which turns fixed gear *D* and sliding gear *B;* a tumbler plate *A* which fulcrums on shaft *C* and carries an intermediate gear *E* for transmitting power to any one of the fixed gears *G, H, I, J* or *K;* an intermediate gear *F* for transmitting continuous motion from fixed gear *D* to loose gear *M,* which carries a pawl and runs on the hub of a ratchet keyed to the secondary shaft *L,* and a device for automatically engaging the pawl or keeping it away from the ratchet.

The slowest speed is obtained by sliding the tumbler plate *A* to the last notch on the right, when the intermediate gear *E* occupies the space between gears *K* and *M,* and the power is transmitted to shaft *L* through gears *D* and *M.* Moving the tumbler plate to the next notch brings intermediate gear *E* into engagement with gear *K,* which makes gear *B* the driver and causes the ratchet on shaft *L* to run away from the pawl in gear *M.* Shaft *L* is therefore always running, for the moment its speed drops below that of gear *M* the pawl in gear *M* acts automatically and keeps it turning at its minimum speed until gear *B* is again made the driver.

As the minimum periphery speed of the smallest driven gear *G* is but 182 feet less than the periphery speed of driving gear *B,* the shock which usually accompanies engaging gears broadside is reduced to a minimum, such shock as there is being absorbed by the belt. Another good feature of this drive is the high belt speed attainable at low gear speeds. Shaft *C* runs at 350 revolutions per minute, while the periphery speed of no gear in the box exceeds 301 feet per minute.

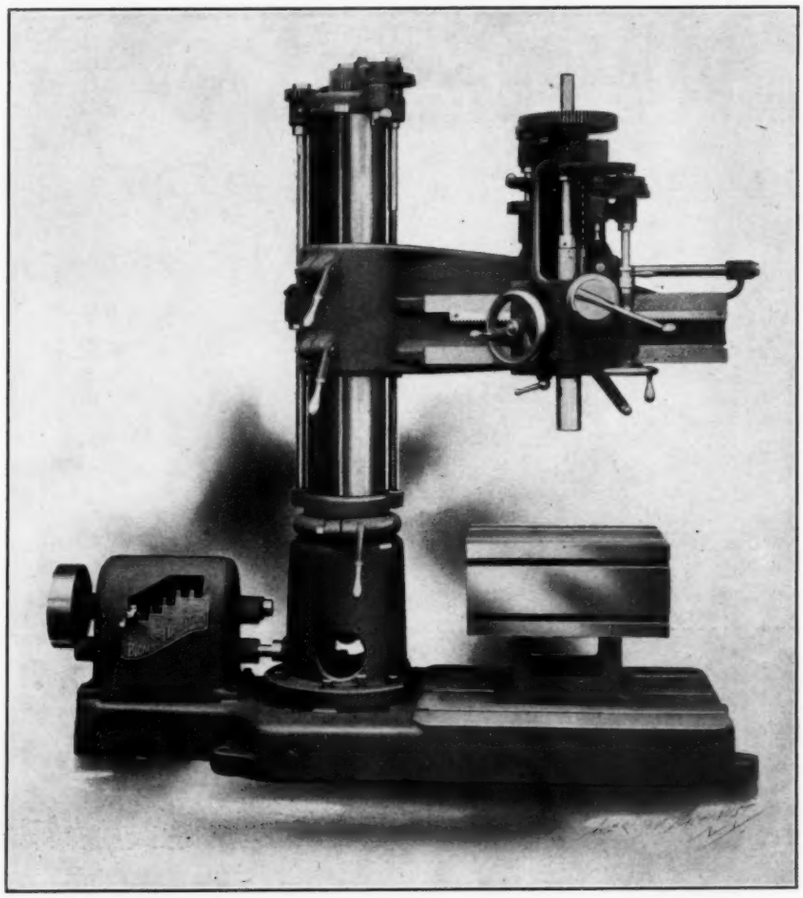


FIG. 1. 2½- AND 3-FOOT RADIAL DRILL.

This speed-box, augmented by the back gears on the head, gives the machine twelve changes of speed, the range and gradations of which are shown in Table 1.

A comparison of the figures in the third and fourth columns indicates that the manufacturers have exercised great care in the selection of gears, as in no instance does the cutting speed vary from the theoretically correct one by more than .84 of a foot per minute. Another point to which our attention has been called is

the irregular gradation of the speeds. The stock expression that " the speeds are in true geometrical progression" has become so common that many tool builders appear to think that no series other than a geometrical series can be correct under any circumstances. That this is erroneous is shown by the example before us.

No. Revolutions per Minute Made by Spindle.	Diameter Drills for which Speeds are Suitable.	No. of Feet per Minute at which Drilling is Done.	No. of Feet per Minute at which Drilling Should be Done.
265.09	1/8	34.60	35.0
209.86	5/32	34.34	34.3
173.68	3/16	34.10	33.6
143.91	7/32	33.07	32.9
122.84	1/4	32.16	32.2
104.29	1 5/32	30.72	31.5
95.41	1 3/16	31.22	30.8
75.53	1 1/4	29.66	29.4
62.51	1 3/8	28.74	38
51.79	2	27.12	26.6
44.21	2 1/16	26.04	25.2
37.56	2 1/8	24.56	23.8

TABLE I—LIST OF SPEEDS.

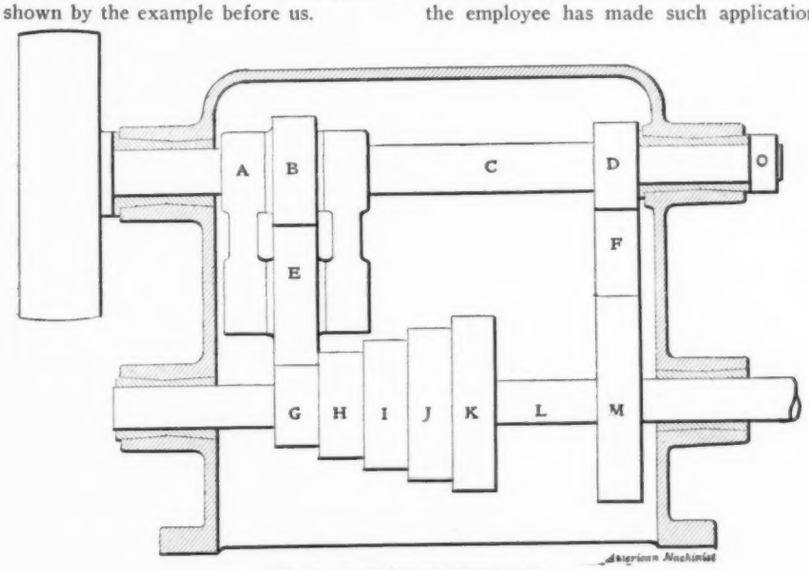


FIG. 2. SECTION OF SPEED BOX.

For the speeds to be in geometrical progression they would have to coincide with the series of numbers given in Table 2.

Geometrical Series.	Diameter of Drills.	Periphery Speeds.
265.09	1/8	34.60
221.90	5/32	36.31
185.81	3/16	36.48
155.54	7/32	35.63
130.26	1/4	34.10
109.04	1 5/32	32 12
91.31	1 3/16	29.88
76.43	1 1/4	30.01
64.00	1 3/8	29.32
53.60	2	28 06
44.85	2 1/16	26.41
37.56	2 1/8	24.56

TABLE 2. SPEEDS IN TRUE GEOMETRICAL PROGRESSION.

An inspection of the table will show that instead of giving a series of cutting speeds in which no speed is more than .84 of a foot too high nor .78 of a foot too low, the cutting speeds in the geometrical series come "any old way" from 2.88 feet too high to .92 of a foot too low. In the one case the maximum error is but 2.47 per cent. and the average error but .834 per cent.; while in the other the maximum error is 8.57 per cent. and the average error 3.903 per cent. or more than four and one-half times greater.

The machine is also furnished with a five-step cone drive, a constant or variable speed motor drive, a swinging or swiveling table, and a round or double-end base, and is made by the Bickford Drill & Tool Company, Cincinnati, Ohio.

Unfair Treatment of Applicants for Positions.

The Patternmaker, in its September issue, presents a leading editorial on the same subject treated by us at page 128, viz., the giving by a manufacturer or other user of labor, to the employer of an applicant for a position, the information that the employee has made such application. One of *The Patternmaker's* subscribers had an experience so similar to that of the AMERICAN MACHINIST reader referred to in our article that it is possible the case is identical with the latter. We are glad to see our contemporary support us in our stand on this matter, the best safeguard against the practice described being the cultivation of a universal public sentiment against it. It is a pernicious practice, and can only result in harm to all concerned.

On June 30, 1904, there were in the service of the railways of the United States 46,743 locomotives, the increase over the previous year being 2,72. The total number of cars of all classes, exclusive of those owned by private companies, was 1,798,561, an increase ot 45,172. Of these 39,752 were in the passenger service and 1,692,194 in the freight work. Of 1,692,194 cars in freight service 1,434,386 had train brakes and 1,674,427 automatic couplers.

Letters to the Editor.

A Dream Trade School.

Since my "Dream Trade School" idea was published, at page 48, I have seen accounts of what two other people think on the same subject and have also had a number of pertinent questions asked me. Not all of these are answerable, at least by me, but one question calls out this: None of the people who have advocated such schools have had much to say about the school side. Of course "the shop's the thing," but if we hope to make the project more successful than the apprenticeship system of commercial shops then the school part must be given some thought.

Mr. Lane barely refers to the school and says that it will probably be necessary to write special text-books, with which I heartily agree. The text-books now on the market seem to be written, and the schools run, on what I call the artificial or bucket plan. That is, it is assumed that the student's brains are like empty buckets into which a certain amount of information can be poured all at once. Of course some will inevitably splash out, if it is dumped in too rapidly; so much is conceded by the advocates of this system. They make a claim, which I do not consider well founded, that concentrated attention on a subject through a short time is better than a more prolonged but less intense application. On the other hand, I believe that it would be necessary for a trade school to use what I call the natural, or sponge, system, in which we liken the student's brains to a sponge, which requires time to absorb a given amount of water, but keeps it where it will not evaporate readily—that is, I would begin as many subjects as possible at the very entrance of the student and begin the others as early as they could be at all comprehended, and I would keep these subjects in hand long enough for their principles to be thoroughly soaked up by the dullest student. Hardly any educators will give this method any hearing, but a practical man, whether originally technically educated or not, will say that that is the way he obtained the part of his education that is of most value and that has stayed by him. It would in this case have an additional value in that the student would have gained something of use to him even if he should leave before completing his apprenticeship.

It is to be presumed that a grammar-school education could be insisted upon as a preliminary to entrance. With that much as a start, a boy who wishes to become an all-around machinist or a foreman could make a beginning at almost every study that he will have use for, if his text-books are written by someone who has the shop point of view and who can get down off the highly scientific plane on which writers of such books usually stand. Then the question comes

as to what studies are of use to a machinist or foreman. Of course we cannot insist on very much for mental training or such things as languages, etc., but a most liberal allowance of mathematics, including a stiff course in arithmetic, especially arranged to cover shop applications, a little algebra, enough to enable students to use formulas intelligently, a lot of geometry, with quantities of original problems, some solid geometry and so much descriptive geometry as can be readily taught in the drafting-room, where I would also teach some kinematics and elementary mechanics. I would add to this something more of the materials of construction than can be gotten by using them in the shop and, a little trigonometry. There is nothing in this list that cannot be carried along from the beginning of the student's course provided some one will provide suitable text-books. It seems like a formidable list, but it is one story to take a list like this where we can take the time to let the instruction soak in and let the student re-learn some of it occasionally, and another story to take the same work and rush it through at college pace. Many a man is doing good work in our shops who dropped out of school simply because, while he retained what he learned, he could not learn fast enough to keep up. To such men this method of instruction would prove a boon, and such men form, in my opinion, a large enough proportion of the rank and file for their needs to demand attention. "ENTROPY."

Pneumatic Feed for a Multiple Drill.

With reference to the note by "Draftsman" at page 250, Part 2, Vol. 28, I would call his attention to the fact that for a number of years a bank of thirty-six drills with patented air feed has been in use at one of the departments of the Pennsylvana Steel Company, Steelton, Pa.

W. T. SEARS.

Factors of Pi.

While reading William Cox's article on "Factors of Pi," at page 298, I noticed in the last paragraph his statement that the value of pi is 3.1415928. With this figure he compares the fraction 113 : 355, which he says is true to .0000001, or about 1 inch in 150 miles. These figures are wrong, the value of pi to eleven decimal places being 3.14159265359, making the fraction 113 : 335, true to 1 inch in 63 miles. However, this is still accurate enough for any practical work. GEO. P. PEARCE.

[The error in the decimal value of pi as given in Mr. Cox's article was typographical, his manuscript giving the final figure as 6 instead of 8. By a really extraordinary coincidence, however, he made an error in calculating the inaccuracy of the fraction $\frac{113}{355}$, and this error agrees with the error of the printer!—Ed.]

A Simple Method of Finding the Area of Irregular Figures.

Although there are a great many ways of finding the area of an irregular figure, it is often a great advantage to know a very simple way by which one can form a close approximation.

Suppose that it is required to find the area of the figure given in Fig. 1. To do this we make a tracing on some thin paper and fold it along the line 2—2, adjusting it so that the areas on each side balance one another, the position when folded being shown in Fig. 2, in which as nearly as may be area a = area b. Next we open the tracing and fold it along the line 3—3, again adjusting it so that the excess and deficiency areas of the lower half balance one another, the result being that each section of the lower half represents one quarter of the original area

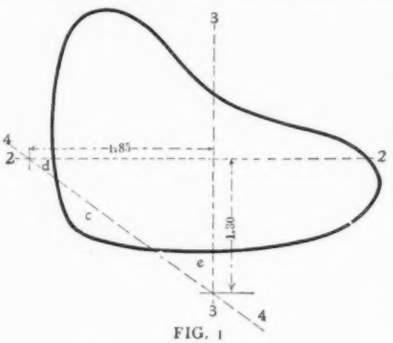


FIG. 1

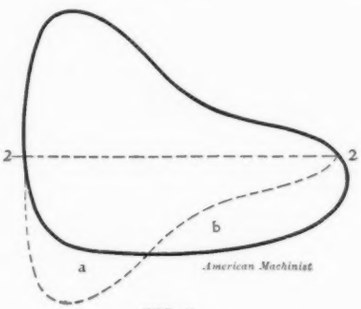


FIG. 2

FINDING THE AREA OF IRREGULAR FIGURES.

and it only remains to find the area of one of these sections and multiply it by four to obtain the total area. This can readily be done by adopting the same principle and folding the paper on the line 4—4, making area c = area d + e and giving the equivalent triangle.

In the example given the two sides of the triangle measure respectively 1.85 and 1.30 inches. Instead of multiplying the area of this triangle by four we multiply the two dimensions together and then multiply by two, which will of course give the same result:

$1.85 \times 1.30 = 2.4050$

$2.4050 \times 2 = 4.81$

= area of original figure in square miles.

If the tracing is made on squared paper no scale will be needed and the calculation can be easily and rapidly made.

It will be noticed, of course, that the lines do not divide the whole figure into four equal parts, but divide one-half into two equal portions. The upper half would have to be balanced in a similar way if a check was considered necessary.

I have compared the areas obtained by this simple method with those obtained by ordinates, triangles and the planimeters and find in all cases that a very close approximation is obtained.

F. HOWKINS.

Making Punches and Dies for Chemical Tablets.

At page 1055, Vol. 27, of the AMERICAN MACHINIST a view of a Mulford tablet machine appeared, so the article I send you might be interesting as well as helpful to the "boys" in the tablet business.

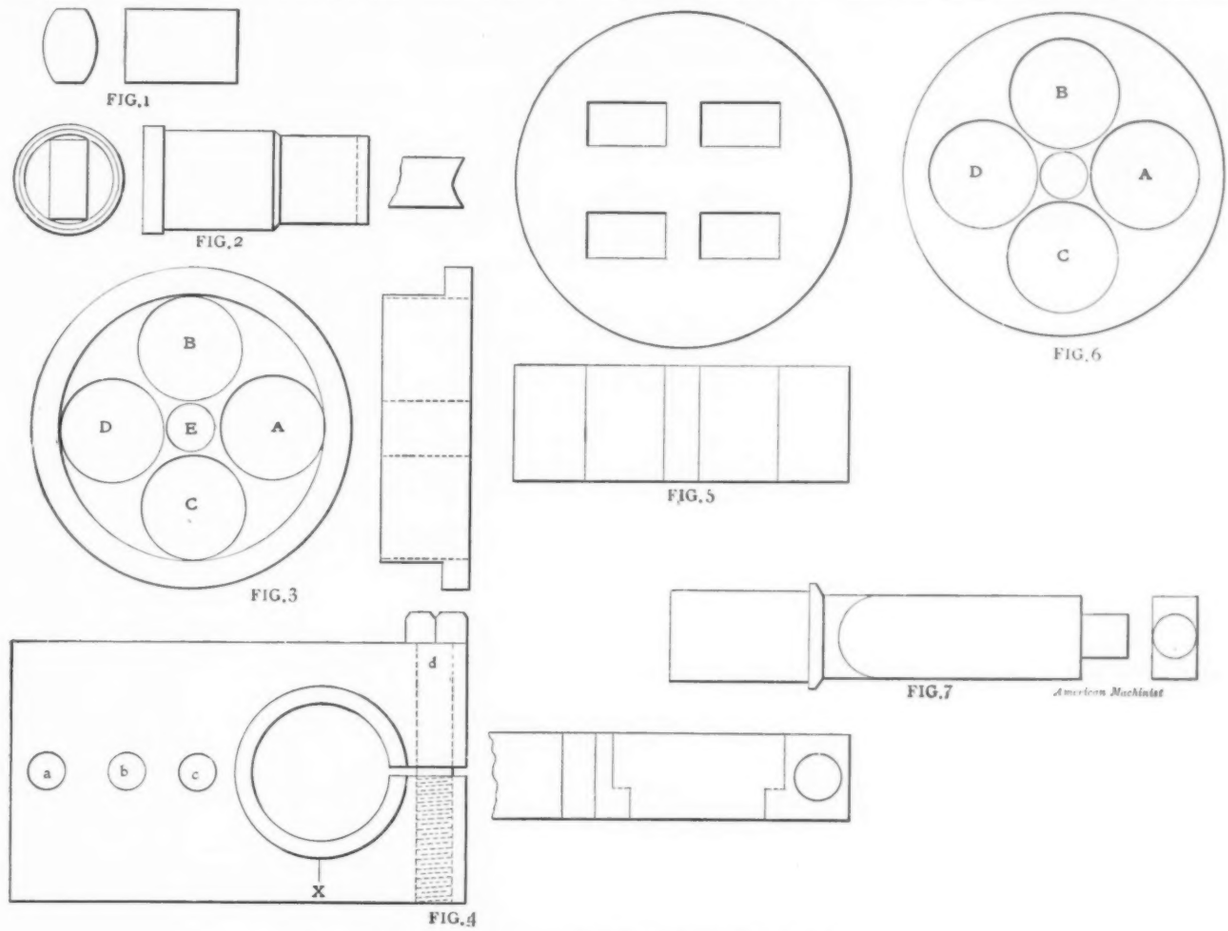
I was employed by the company to help build a dozen multiple presses, Richards patent, but was gradually worked into the die-and-punch end of it, and that is what I wish to write about. They wanted to make a tablet like Fig. 1 (the size of which is exaggerated in the drawing), and make them on the heavy multiple press, four at a time, so I was called over to the foreman, and the job was explained to me. Fig. 1 contains 40 grains of powder and is made, you will notice, quasi-hexagonal in shape, with two corners rounded and a very small radius at the other four corners, two sides only being flat. This is done for three reasons: First, it has to pass through the neck of a bottle, which it could not do if it were a perfect hexagon, the neck of the bottle not being large enough; second, it assists in releasing it from the top of the punch; third, it strengthens the punch, which is made like Fig. 2. The job required eight punches like Fig. 2, four of them longer than the other four; a die like Fig. 5; two punch-holders like Fig. 3, and a head ring like Fig. 6. The die had to be as hard as possible without cracking and the punches hardened and drawn a light straw, as the powdered medicine is very hard on dies and punches; they have to be a working fit and highly polished. The president of the company asked if he could have it by Saturday, and this was Wednesday noon. I do not know what the foreman promised and cared little, as it was the first decent job I had had in a year, as the other work I was familiar with I had worked at before.

The first thing I did was to hunt for a piece for a temporary jig, as they did not have time (they said) to make a jig like they have for their regular multiple dies and holder. I found a piece like Fig. 4 (gray iron) which I faced off on both sides; then I laid off the tapped holes *a*, *b* and *c*, and clamped the casting to the face-plate—using tapped holes *a* and *c*—laid out the circle the diameter of the die and bored it out one inch deep to fit the

die; the balance of the hole fitted the small diameter of the holder, Fig. 3. I next put a circle on the face-plate as large as possible, then laid four equidistant points on it; I then put it on the lathe and put my blanks for Fig. 3, 5 and 6 and faced them on both sides (held them tight by tightening screw *d*). I then put a ⅜-inch hole in the center of 3 and 6, put Fig. 6 in the holder Fig. 4 and made a tram, and after putting one end of the tram in a light punch mark previously put in the lathe bed and the other end in one of the four divisions in the face-plate; I drew a line at the center height on Fig. 6 with a pointed tool in the tool-holder, then I turned the face-plate to the next division in the face-plate and scribed another line, and so on, until I had four lines on Fig. 6. The last line I drew from Fig. 6 to the holder Fig. 4, as shown at *X*, then I moved the holder Fig. 4 11-16 inch, which is the center distance of the holes *A, B, C, D*, from the center *E* of the punch-holders Fig. 3 and the head ring Fig. 6, using *a* and *b* tapped holes and put my first hole in and reamed it. Then loosened screw *d* and turned the head ring until the next line came on the line *X* and put the next hole in, etc., until I had it finished as to boring. I then took holders Fig. 3 and put a hole in each of them, and then made a plug to fit the hole in the two punch-holders and the head ring, also a plug to fit the ⅜-inch hole in their centers. I then put one of the punch-holders and the head ring plugged together in the jig Fig. 4 with one of the lines on Fig. 6 in line with the line *X* on the jig and bored the next hole in the punch-holder, then loosened screw *d* and finished like I finished the head ring, and then finished the other the same way. I next put each piece on a ⅜-inch mandrel and finished them outside. I then took the jig off the lathe and put the die Fig. 5 in the one side and a punch-holder in the other and clamped them with *d*. I then bored a piece .368 and turned it to fit the holes in the punch-holder and hardened it a little. I then drilled the die with a .368 drill. I next made a broach like Fig. 7 (the milling for broach and punches I had to do in a neighboring shop). I made the broach .006 smaller than the punches and turned a tit on the end to fit the hole in the die. I then put the round end of the broach in the die and scribed for the punches, then I drilled the die and cut and filed the stock so the broach would enter. Then I laid off a small piece and filed and broached it to fit the broach, then I turned it to fit the punch-holder. I then tightened the die and punch-holder together in the jig and put the broach guide in the punch-holder and broached and filed the die a little at a time until finished. Expected trouble after tempering, but had very little.

The punches I cut off so that I could make two out of one piece, four ⅝, one large and one small like Fig. 2. I faced and turned them straight 1-64 larger than size, then I milled them 11-16x⅜ square, then finished turning them, using the "mikes" for size (milled the punches in the center of the pieces). I next sawed them in two and fitted them to the die and put them in the punch-holder which fits in a nut and is clamped to a plunger. I then put them in the lathe and faced them the same length. I next took the bottom punches and put them in the head ring and punch-holder, and after having them in the plunger I slipped on the die to keep the punches from turning, and faced them. I could not do this to the top punches, as they would not reach through the die. Now I have the top punches the same length, likewise the bottom punches. Next I made an end mill the shape of the top and bottom of the tablet and milled the ends of the punches and then polished and tempered them, after which they were polished again.

I completed the job in 19 days instead of 3½, and I worked very steadily at it, as it is my habit to do, and I was just



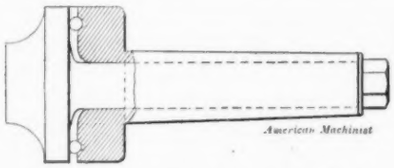
MAKING PUNCHES AND DIES FOR CHEMICAL TABLETS.

as anxious to see the punches and dies working as they were, and my wish was gratified before I left the shop.

AMATEUR.

Finding Diameter of Shell Blanks.

The article at page 60, Part II, on this subject, by E. W. Zeh, is one which most press toomakers will welcome. Articles of this kind are all too scarce, and I for one will be glad to see others. Meantime, however, I have a few hints to offer to our



LATHE CENTER FOR HOLDING BLANKS.

less experienced diemakers, many of whom will of necessity have to stick to the old cut-and-try methods.

When making dies for drawing shells, and the size of blank is not definitely known, a series of concentric rings, marked lightly on the face of the die before taking from the lathe, will greatly facilitate the centering of the blank for the trial. They need not be deep marks, and if numbered lightly, 1, 2, 3, 4, etc., will be the better. When the right blank has been found the die can be rechucked and the set-edge turned to suit it.

The sketch shows a center with ball thrust for holding a blank for turning the edge. It is fitted in place of the center in the tailstock, and a piece of gray iron is held in the jaw-chuck, and turned a little less in diameter than the blank to be turned. It is turned on the face and a piece of brown paper is placed between it and the blank which will be held firm and may be turned on its edge to any desired diameter.

CYCLO.

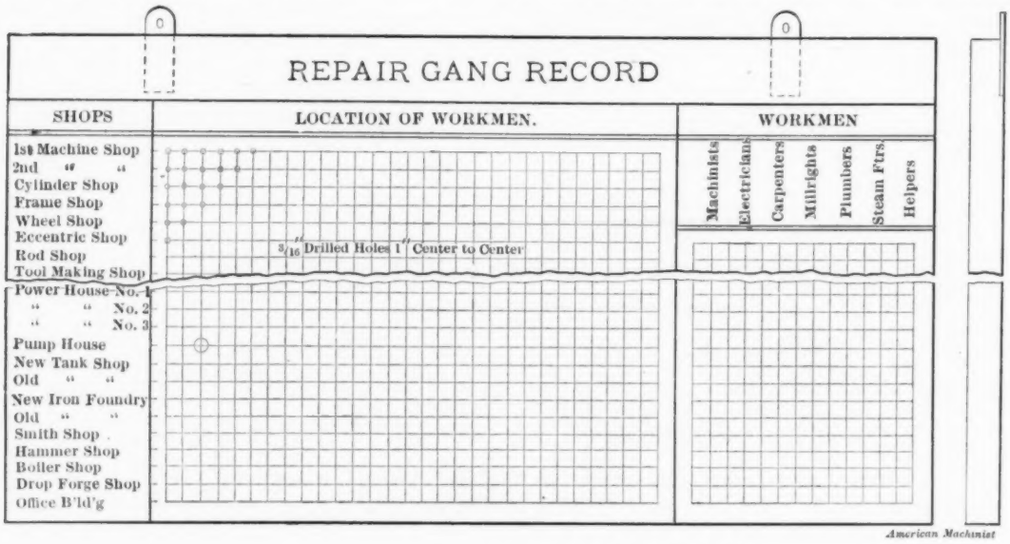
Locating the Repair Gang.

I was very much interested in the article at page 121, Part II, by Geo. P. Pearce, on his method of keeping check on the workmen and comparing the steady and faithful ones with the tardy and indifferent class. I think if these monthly sheets were posted on a bulletin board in the shop where the workmen would have free access to them, each and every man would be inspired to keep his line as long, and longer if possible, than the other fellow. Mr. Pearce's article prompts me to write of a system, for a little different purpose, which we use in the repair department of a concern employing on an average about 5,000 men at one of its works.

A grand rush of orders, introduction of high-speed steel on old machines and the improvement and enlargement of the works to double its normal capacity, made it necessary to employ from 300 to 400 men in the repair department, which department I wish to speak of. With all these men scattered about the fifty-odd buildings, covering nearly twenty acres, you can readily see it was no small job for the works engineer to keep track of them. After considerable scheming the system here described was adopted.

The tally-board, which is made of 2-inch polished maple and of sufficient size to accommodate the number of men in the department, is ruled up and drilled full of 3-16 inch plug holes, as shown by the sketch; this board is hung on the wall of the repair shop office, and is operated by the clerk, who receives all the notifications of breakdowns, etc. There are several trades represented in the repair gang, and each gang is of course under a foreman. Each man is represented on the board by a wooden plug, which has his name and number printed on its face, and to draw a line of distinction between the different trades, so a foreman can at a glance at the board locate his particular men, each trade is represented by a color. The machinists' plugs are painted black; electricians', red; carpenters', white; the millwrights', green; the plumbers', blue; steam-fitters', lead color, and the helpers', yellow. On the right-hand side of the board, under the heading "Workmen," is the space where all the plugs are kept when the men are not working or before they have been assigned to their jobs. I think it would be a good idea to add a sick list and absent list to the board; it would save a good many questions as to where is such and such a man. On the left-hand side of the board is printed a list of the shops, and for each there is a row of 3-16 inch holes to receive the plugs of the men assigned to that particular department.

To illustrate the working of this system, say the repair office clerk receives notice either by one of our breakdown report slips or by telephone, that pump No 2,201 in the pump-house is in bad shape and should be repaired at once. Now, Eddie, the clerk, who is a sort of mechanic himself, knows his men pretty well, and knows which particular man he would like to have on that job. After glancing at the board, he at once sees that his man, Jones, is down in another shop near the pump-house, and remembers that his job can be finished later, as it is not required in any particular rush; so he fills out a repair slip and sends Jimmie,



LOCATING THE REPAIR GANG.

Detail of Plug Arrangement

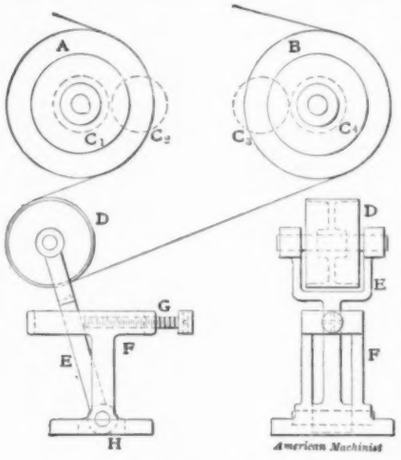
the kid, down to Jones with the order for Jones to proceed to the pump-house at once and fix the pump. After Jones has the pump in good order again, the engineer in charge at the pump-house affixes his O. K. to the repair slip, and Jones reports to the repair shop, the repair slip is handed in as finished, and the clerk gives it a stamp with the automatic time-recorder, as he did when he sent the order out. Jones is assigned a new job or the

one he left, and so it goes with the whole force.

The works engineer can be seen many times during the day consulting this board to see how the different jobs are being rushed, how many and what men are on a certain job. After a few words with Eddie things are made quite plain to him, and he sees the force in motion without making the rounds. BAYARD.

An Effective Foundation Idler.

The illustration shows a foundation idler used for securing a double pulley



A FOUNDATION IDLER.

drive for a sand grinder. *A* and *B* represent two 300-pound balance wheels, each made to drive two separate pairs of rolls C_1 C_2 and C_3 C_4. The power was obtained from a 15 horse-power motor, situated on a bracket about 8 feet away. It was found impracticable to put an off-set pulley on the motor and use two separate drives, as the balance wheels were keyed to shafts which were turned on the rolls. The cheapest and most effective way, therefore, was to drive both wheels through an intermediate loose pulley. As it was impossible to secure any adjustment by attaching anything to the machine, a gray-iron bearing and guide *F* was made, which was secured to a concrete foundation by four bolts. The loose pulley was carried by a yoke *E*, one end of which was made to swing in the guide at *H*, while the other end carried the pulley. Adjustment was secured by means of a screw working in the guide *F* and bearing against the yoke. The head of this screw was provided with holes, which enabled the operator to insert a bar and adjust the belt tension. It was essential that the friction on the driving wheels should be positive, as the feed on the rolls was inconstant. Should any slip have occurred in the belt the arrangement would have been useless, as each balance-wheel was fixed to a roll which turned its mate in the opposite direction through spur gears. This apparatus will be found advantageous to use where the frame of a machine is too weak to stand the vibration caused by such an attachment, or where there is no space to place a separate motor to operate the second wheel.

W. T. M.

Cageless Roller Bearings.

Having noticed the remarks of your correspondent, "Theodore," at page 54, Part II, concerning "Cageless Roller Bearings," we venture to give you some particulars of a roller bearing of this type, "which we have now been using with marked success for a number of years," thinking they will be of some interest to your readers. Our experience has shown us that a roller bearing, either of the caged or cageless variety, must be made, in order to be successful, of the best material and with the greatest possible accuracy.

We enclose a photograph and a sketch of the cageless bearing in question, which we use upon the live axle of several types of motor cars which we manufacture, where it has given every satisfaction. This bearing has rollers whose length is equal to their diameter, the end faces being carefully ground and the limit of variation allowed on the length being 0.001 inch. The rollers are ground truly parallel and round to within a limit of variation of 0.0005 inch, the rollers being ¾ inch in diameter. Referring to the sketch, *A*, *A* are the rollers and *B*, *B* mild-steel plates, between which they run, and which are ground on their inner faces; these plates are preferably case-hardened. *C* is a cast-steel sleeve, pressed on to the shaft and accurately ground on its periphery. *D* is a cast-steel bushing pressed into the housing and ground on its internal diameter, the limits in both cases being 0.001 inch. Both bushing and sleeve as well as rollers are hardened. The maximum load on this bearing is about 800 pounds, and the maximum number of revolutions about 300 per minute, the bearing being subjected at the same time to considerable shock.

Our experience shows that for bearings of the cageless type it is undesirable that the length of the roller should be appreciably greater than its diameter, otherwise the roller will get askew and bind on the ends, as your correspondent discovered. While the above bearing is somewhat expensive to construct, it has proved itself quite satisfactory under very severe conditions, and where the saving of power is a consideration the expenditure is amply justified.

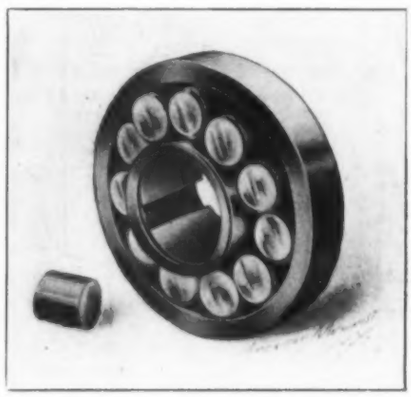


FIG. 1. A CAGELESS ROLLER BEARING.

The double lines at the ends of the rollers in the sketch represent a slight chamfer, and not a clearance, as would appear at first sight, the clearance in this direction being only about 0.002 inch.

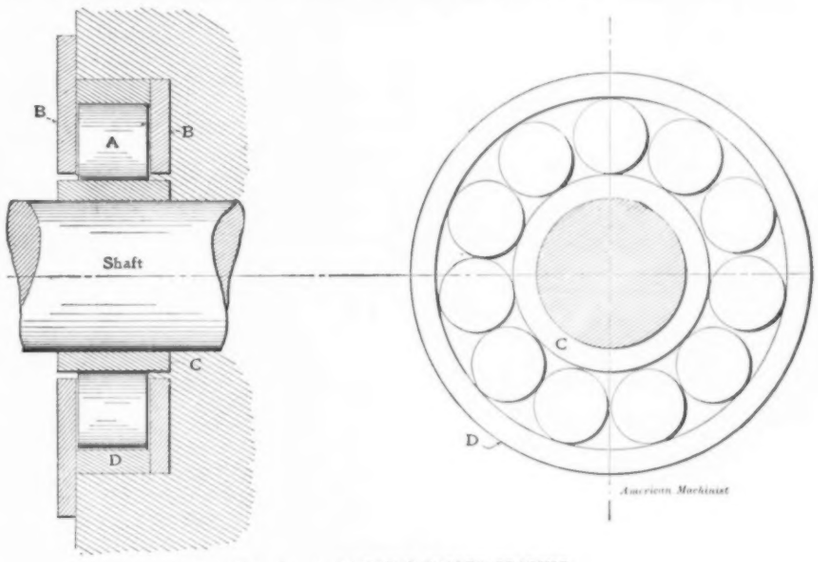


FIG. 2. A CAGELESS ROLLER BEARING.

In conclusion we may say that we doubt whether a satisfactory roller bearing, either of the caged or cageless variety—more particularly the latter—can be made sufficiently cheap to justify its use on ordinary loose pulleys and in similar situations, as suggested by your correspondent,

THE LANCHESTER MOTOR CO., LTD.
Birmingham, England.

The Division of Logarithms.

Referring to "The Division of Logarithms," by G. M. J., at page 226, the usual method of finding logarithms of roots of fractions is: Add 10 times the index of the desired root to the characteristic; divide the sum by the index and subtract 10 from the quotient. The remainder is the logarithm of the desired root.

Example: Find the log. of the cube root of 0.3047:

Log. 0.3047	$\bar{1}.48387$
add 3 times 10	30.
divide by	$3)29.48387$
	9.82796
subtract	10.
log. cube root of 0.3047	$\bar{1}.82796$

M. L. H.

At page 226 I find an article, "The Division of Logarithms." The method seems a little roundabout, as there are two subtractions which can as well be avoided. The same problem $\sqrt[3]{.3047}$ may be easily solved as follows:

$$\text{Log. } .3047 = \bar{1}.48387 = 2.48387 - 3$$

$$\frac{2.48387 - 3}{3} = .82796 - 1$$

$$= \bar{1}.82796 = \log. \sqrt[3]{.3047}$$

The only principle used here is the adding and subtracting of the smallest multiple of the required root, which will make the characteristic positive.

ORSON A. CARNAHAN.

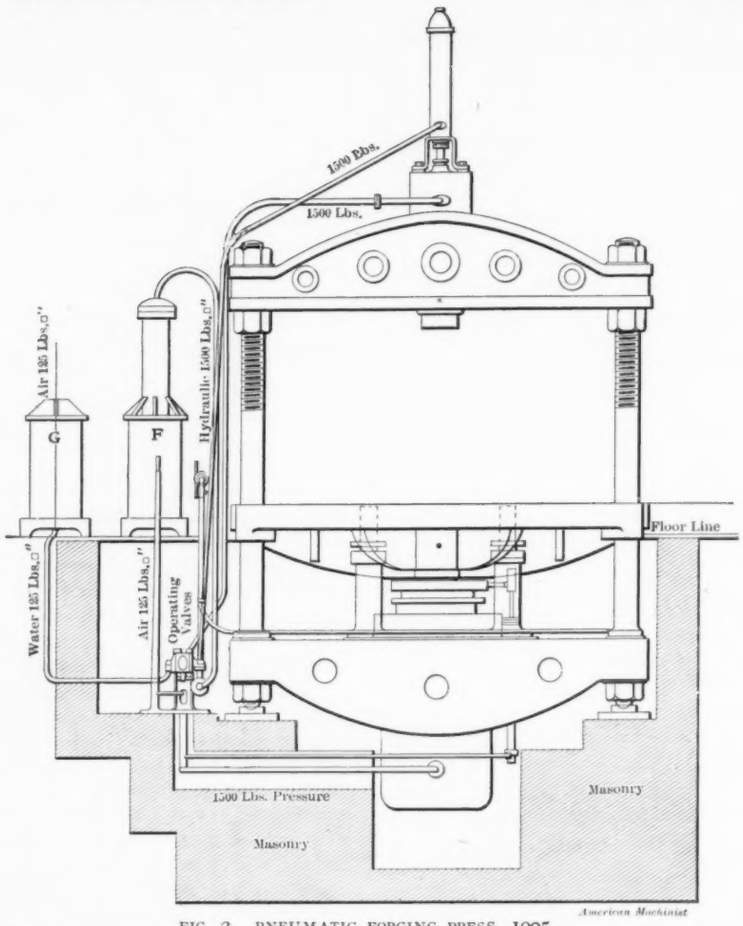


FIG. 2. PNEUMATIC FORGING PRESS, 1905.

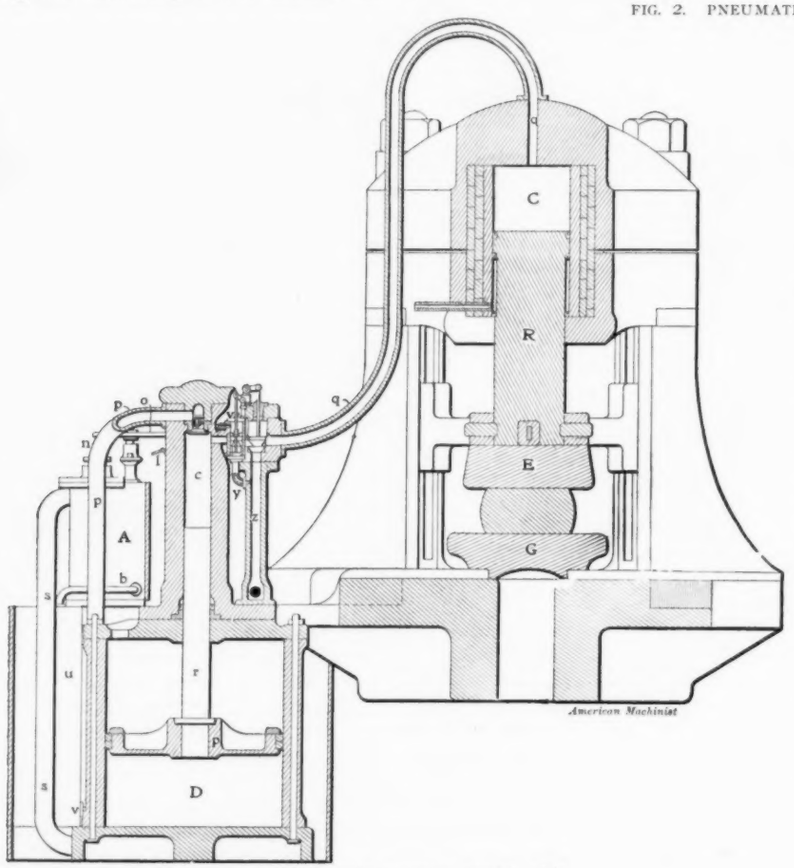


FIG. 1. SHANK'S FORGING PRESS, 1869.

A Forging Press of 1905 and one of 1869.

A few days ago I was looking over an old volume of *Machine and Hand Tools*, published in 1869, and ran across a cut and description of "Shank's Forging Press." It occurred to me that I had lately seen a similar device illustrated in a magazine of this year, and the statement made that it was new. A short search served to unearth the article I had in mind, and I was so much struck with the similarity of 1869 and 1905 that I thought the matter worthy of record, and am sending you herewith photos and descriptions of the two devices. The difference consists only in the use of steam in the place of compressed air.

Hardly any description is necessary, further than to state that in Shank's press, Fig. 1, steam was admitted on top of water in the cylinder *A*, and the first movement of the plunger obtained by water under this pressure. When the plunger had completed the idle part of its stroke the steam was admitted to cylinder *D*, and the differential plunger *r* gave the required water pressure to do the work.

The "new" device, Fig. 2, admits air on

top of water in the cylinder, and the first movement of the plunger is obtained by water under this pressure. When the plunger has completed the idle part of its stroke the air is admitted to the cylinder *F*, and the differential plunger gives the required water pressure to do the work.

I wish it understood that I am not condemning the latter device in any way, but the extreme age of the resurrected seems to call for some slight comment.

W. T. SEARS.

Fixtures for Use in the Arbor Press.

Having spindles varying in length from 5 to 60 inches, on which flanges were to be forced, and having a No. 3½ Greenerd arbor press with a capacity of 13 inches, and it being necessary to force the flanges on the spindles in such manner as not to bend or spring the spindles (which must run true within a limit of 0.0015 inch), the fixtures shown herewith were devised.

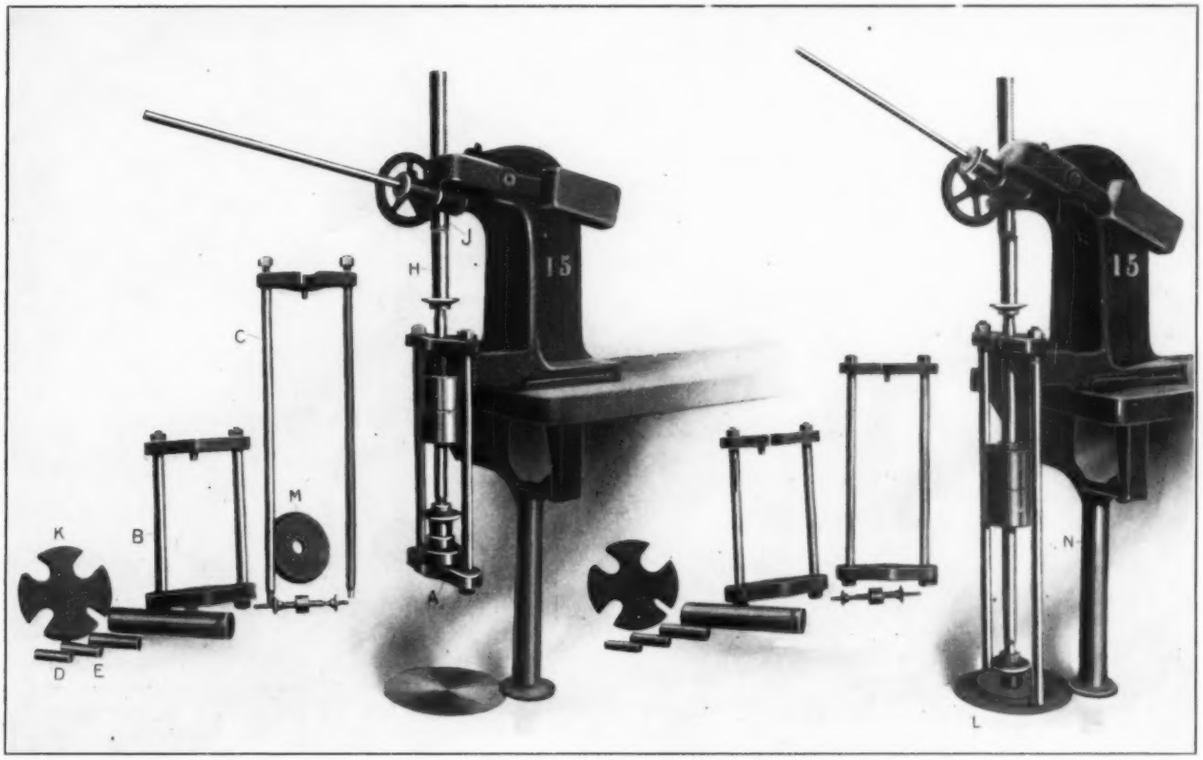


FIG. 1. ARBOR PRESS ATTACHMENTS. FIG. 2.

In Fig. 1 fixture *A* is shown on the press with flanges in place on the spindle ready to be pressed on, also fixtures *B* and *C*, one of which is for shorter and the other for longer spindles than the one in the press. *D*, *E*, *F*, *G* and *H* are collets of various sizes, with one end blind, for putting over the end of the spindle, the open end coming in contact with the flange and the other with ram *J*.

The fixtures consist of two yokes of gray iron about 1½ inches thick, connected by rods. The upper yoke is provided with a dowel pin on the under side which locates the fixture on the press in the same manner as regular plate *K*, and has an open slot at the front edges. The lower yoke has no dowel pin or slot, but has a hole through the center. In Fig. 2 the long fixture is shown in the press, with a spindle about 54 inches long whose flanges are in place ready to be forced on. For this fixture and also for convenience for other special, long work, a piece of gray iron pipe about 3 feet long has been sunk so that its upper end is just flush with the floor. This is held in position by cement. Flange *L* on the pipe is faced up and counterbored for plate *M* (Fig. 1), and drilled and tapped for rods *N*. It will be seen that the press is held on the bench with a bolt through the base. Flanges can be forced on both ends of the spindle at the same time. The fixtures have been in constant use for over two years, giving entire satisfaction. They have also been found useful for various other classes of work.

J. A. SKERRY.

Locating Machinery on the Floor—Solving Belt-Drive Problems With Models.

When a big sawmill goes up in smoke, leaving many million feet of logs unsawed, every day that elapses before the new plant gets running means lots of dollars lost; and as a few hours saved in the drafting room may mean days in the shop and, perhaps, even weeks in setting up the machinery and getting into running order, a small saving here proves quite frequently a big one in the end.

As few mills are ever re-built in duplicate, and a general re-arrangement is usually desired, it often happens that a deal of penciling and erasing must be gone through with before all the parties interested are satisfied and everything works together without interference in the general plan. The man who can best plan and operate a large lumbering plant may be a very poor hand at "seeing things" on paper, or at explaining his ideas to the draftsman. Even if this is not the case, the determination of how much space on the plans shall be allotted to each machine is often a slow and tedious job, but one which must be thoroughly studied out or a continual loss in the operation of the plant will be the result.

So I have adopted the plan already described in your columns of using bristol-board models, each of which is a ground plan of one of the principal machines drawn to the same scale as the general plan and then carefully cut to its outline. These can be shoved about at will on the drawing and their relative locations changed about until the one that seems best is finally arrived at. Then a pencil point is run around them and they are laid away for the next job.

When, as sometimes happens, the preliminary sketching is done on the site of the proposed mill, with an old barn door for a drawing board and shingle nails for thumb tacks, this scheme is more than ever useful, though if the diagrams were cut from tin they might prove more stable for open-air use.

For general reference I have similar diagrams to a larger scale, each on a page by itself in my loose-leaf information, and these are much more complete, giving such items as the height of the drive pulley from the floor, the same dimension for feed rolls, location with reference to the end of the machine of the principal parts, and anything else of that sort that may be useful to have at hand in making plans to include this particular machine.

I believe it pays to be generous with information that is likely to be useful to a possible customer, and these sheets are easily blueprinted and can be sent out with letters when catalogued dimensions would be rather too bulky. While this is more in the province of the selling department than the manufacturing, the draftsman is a sort of go-between for these divisions and must look out for both in a measure.

Another adaptation from the kindergarten that I have often found useful is half a dozen wooden wheels, about ¾ inch thick, and a couple of yards of cotton webbing. With it one can solve belting problems in a few minutes that would take hours over the board, and show up the results with a conclusiveness that not even the densest imagination can fail to grasp. A freak belting arrangement is not an easy thing to show on paper in such a way that the untrained eye can follow its scheme. E. R. PLAISTED.

Rotating a Shaft 180 Degrees Without Dead Center.

In regard to the article on pages 123 and 257, "Rotating a Shaft Through 180 Degrees Without Dead Center," it seems to me that it is Mr. Ulmann who has "strained at a gnat and swallowed a camel." When I first read of the device, at page 123, I put it down in my memory as a very ingenious device that I might find a use for in my business some day. I had studied out the movement quite carefully and found nothing the matter with it, and was therefore surprised to read at page 257 Mr. Ulmann's criticism, with your editorial backing. I immediately referred to the original description and began a hunt for the fatal mechanical error. Not being able to find one, and being unwilling to doubt the finding of a mechanic of Mr. Ulmann's standing without better evidence than unassisted reasoning, I at once set to work to construct the device, and though my tools were jack-knife and scissors, and my material pins, cardboard and a lead-pencil for a shaft, I am pleased to say that the rig works perfectly, and shows no tendency whatever to "move crank *a* upward, while crank *e* moves downward," but it does do just what Mr. Osterhom claimed for it: rotates a shaft through 180 degrees without dead center.

The rod *c* is to be reciprocated by an eccentric or other suitable means, and the free end of the rod supported only by the device itself in the same manner as the hook of a Corliss engine is supported by the wrist-plate rising and falling with the motion of the cranks.

The motion of the shaft will not be absolutely uniform, no such thing, so far as I am able to discern, being claimed.

There is, of course, no reason for the double crank at each end of the device, one double crank with the arms separated laterally far enough to allow the links and connecting rod between them being doubtless what was intended.

I do not know Mr. Osterhom, and have never heard of this device, except from the sources above stated.

STRAWBOSS.

[Upon a thorough examination of the letters of our correspondents, we are convinced that both are right, and that the apparent variance in their conclusions is due to the fact that Mr. Ulmann has assumed a restricting condition which "Strawboss" has not. The description at page 123 states, "The actuating rod *c* is rigid." It was perhaps this statement that Mr. Ulmann took as the basis of his assumption "that the reciprocating rod *c* travels in a straight line." We were, and still are, quite satisfied that under this restriction the exception taken by Mr. Ulmann was justified, and that if the rod *c* be prevented from moving downward, his statement about his Fig. 3 is correct.

If, however, as in the case assumed by "Strawboss," the rod be permitted to rise and fall like the hook-rod of a Corliss valve-gear, the device will operate, as we stated at page 257. This would probably be the more usual arrangement.

We also have now made a little model of the movement, and as a result we recall the last sentence of our editorial comment at page 257, which stated that there was no doing away with the dead center.—ED.]

The Manila Electric Railway.

There has recently been put into service in the capital city of the Philippine Islands an up-to-date plant of American design, which may serve as a training school and an object lesson in engineering for the natives. This is the plant of the Manila Electric Railway & Light Company, which includes ninety-five two-motor passenger cars, and a power-house with four turbo-generators, aggregating 4,000 horse-power, for power and light. The car motors and the turbo-generators are of Westinghouse make. The car bodies are European, the trucks American.

Native labor was employed in the installation, the pay being from 50 to 70 cents per day. Even this sum, however, which was almost twice what they got under the Spaniards, appears to have been almost too much for the Filipinos, because they did not see the necessity for working continuously when earning such wages, and holidays were innumerable. The natives are employed as conductors and motormen, and many of them also as carpenters and machinists.

The weather and the white ants made the problem of the material for ties and poles a difficult one. The woods experimented with for ties were a native wood called molave, California redwood, and an Australian wood; moreover, preservatives such as creosote, jodelite, solignum and carbolineum were tried. The rails were painted with asphaltum, and in low-lying ground were laid in concrete.

The cars were built of teak combined with steel, the steel being well protected with paint; the teak does not require chemical treatment.

The power-house, car barns, etc., are of steel and concrete. The plant was built and is being operated by J. G. White & Co.

Franz Reuleaux.

In the death of Professor Dr. Franz Reuleaux, of which the announcement has recently been made, the engineering profession on both sides of the ocean has experienced a distinct loss. To many engineers in the United States he was known as a warm friend, and by all he was accepted as an exponent of what he himself called the union of science and practice in the art of the mechanical engineer.

Born September 30, 1824, at Eschweiler, near Aachen, in Germany, Franz Reuleaux was the fourth son of Johann Josef Reuleaux, the founder of one of the early machine shops of Germany. His natural inclination toward the subject of mechanics was most fortunately developed under one of the ablest of German engineering instructors, the famous Redtenbacher, then professor of machine design at the Karlsruhe Polytechnic School, and the friends of Reuleaux himself know with what mingled reverence and affection he always spoke of his early master in the science which he himself so fully advanced. From Karlsruhe the young Reuleaux went to the University of Berlin and to the University of Bonn, there pursuing the broad course in philosophy, and it is a characteristic instance of the future career of the technical author and teacher that even before he had finished his course at the University of Bonn he wrote his early treatise on the strength of materials, being assisted in this by the engineer Moll. In this work and in its successor, also prepared by Reuleaux and Moll, upon the construction of machinery, the modern notions of the elastic theory and the working fiber-stress first appear, in distinction from the old method of employing only the ultimate resistance of the material, tempered by an assumed factor of safety; and from the very beginning Reuleaux strove to teach the importance of accurate and precise knowledge of the actual conditions of work, as opposed to empirical and uncertain

methods, then so much in vogue. Thus, there was at that time no definite experimental knowledge of the action of springs, and this lack he supplied by careful experiments, the results being published in 1857, and afterward embodied in "The Constructor," and now accepted and used as authority everywhere.

In 1856, being then but twenty-seven years of age, Reuleaux was called to the professorship of mechanical engineering in the Zurich Polytechnikum, and here for twelve years he formed one of that energetic band of scientific engineers which did so much to create the fame of that institution. It was at Zurich that Reuleaux developed his science of machine design, and there he wrote his first great work "The Constructor," modestly called by him a handbook of machine design, but destined, in continually enlarged editions, and through translations into

F. Reuleaux

French, Swedish, Russian and English, to revolutionize the practice of machine design everywhere. The first edition of "The Constructor" appeared in 1861, and this was followed in 1875 by what is doubtless his most original work, the "Theoretical Kinematics." This remarkable work is nothing more nor less than an attempt to bring the entire science of mechanical movements into a systematic form, this plan involving the invention of a new notation permitting any combination of parts to be represented by a written formula, so that, however deeply the actual mechanism might be concealed within the construction, its identity would be fully revealed simply by writing its obvious formula. In this work some vital and fundamental principles were brought out for the first time, a single example of which will serve to illustrate. Thus, in the case of a revolving crank with a connecting rod joining it to a rocker arm, the older writers considered this simple combination as composed of but three parts. Reuleaux, however, perceived that the frame or bed-plate, or even the floor, by which the axes of the crank and the rocker were held in their positions, formed a fourth member, the whole thus consisting of a closed chain, or circuit, of which any member might be considered fixed and others free to move, and the various "inversions" of such a system lead to interesting combinations. The conception of "centroids," and numerous other illuminating features, as applied to machine design, render this an epoch-making treatise for the thoughtful engineer. The "Kinematics" has been translated into Italian, French and English, the English translation, by Sir Alexander Kennedy, being especially noteworthy.

In the meantime the brilliant young professor had been called from Zurich to Berlin, to become professor of mechanical engineering at the Royal Technical Academy, and when this institution was united with the Royal Academy of Architecture, to form the great Royal Technical High School at Charlottenburg, known all over the world as the Königliche Technische Hochschule, Reuleaux was made its director, a position which he held until 1896, when he retired, having completed his 40 years of active professional work.

In 1876 Reuleaux was appointed commissioner from Germany to the Philadelphia Centennial Exposition, and there he showed his capacity to rise above petty considerations and speak a wholesome truth even though it meant facing great unpopularity. In his little book entitled "Briefe aus Philadelphia," or "Letters from Philadelphia," he expressed such a vigorous criticism of the German exhibits as to awaken in his own country an agitation which, first directed against his own temerity, ultimately aroused the nation to that remarkable state of engineering eminence which she holds to-day. It was in these letters that the expression *"billig und schlecht,"* or "cheap and nasty," was applied by him to the distinctly inferior German exhibits of machinery, but when again he represented his country as commissioner to the Chicago World's Fair in 1893, this opinion was changed by himself, in speaking of the splendid German display, into terms of the highest commendation.

From the beginning of his work Reuleaux placed reliance upon the use of working models as illustrations of mechanical conceptions- and visitors to-day to the Zurich Polytechnic may find in the cabinets some of the early models made and used by him. At Charlottenburg this feature of his work became greatly extended, and the Reuleaux cabinet of kinematic models forms a noteworthy portion of the equipment of that institution. Copies of many of these models have been made for other educational institutions, the most complete being at McGill University at Montreal, and at Cornell University, at Ithaca.

Since his retirement from the active work of instruction, Professor Reuleaux devoted himself to consulting practice and to the continuation of his literary work. The second portion of his "Kinematics" appeared in 1900, this being termed "Applied Kinematics," as supplementing the former "Theoretical Kinematics," and he has also prepared numerous papers for presentation before technical societies. As honorary member of the American Society of Mechanical Engineers, Professor Reuleaux contributed a paper upon "Friction in Toothed Gearing," this being presented at the New York meeting in 1886.

While Professor Reuleaux achieved fame as an engineer and as a technical writer and instructor, he was, to those who knew him intimately, a man of broad culture and many-sided acquirements. A remarable linguist, speaking French, English and Italian fluently, he was versed in literature and arts as well as science. As an example of the brilliant literary capacity of the man, he visited, during his stay in America in 1893, the Minnehaha falls, and this incited him to make a complete translation of Longfellow's poem "Hiawatha" into German poetry of a high order, this difficult piece of work being done in what was supposed to be a vacation from his professorial duties. His remarkable address, "Kultur und Technik," delivered in Vienna in 1884, a translation of which has been published in America by the Smithsonian Institution, is another example of his broad survey of the field of art and science.

Apart from his engineering work, he filled the position of a trustee of the Royal Museum of Arts at Berlin, and was a member of the Commission for the Purification of the German language. He was also honored with the appointment of Royal Privy Councilor, while the list of his academic degrees and memberships of learned societies in all lands would fill a column.

Ill health had been overtaking him for nearly two years, and the end came August 20, 1905, at his beautiful home in the Ahornstrasse in Berlin, he having nearly reached his seventy-sixth birthday, his remains being interred in the grounds of the Church of the Holy Apostles at Berlin. H. H. S.

The *Railway Age* says: "The Boston & Maine has experimented with peat for locomotive fuel, the peat being furnished by a company who are exploiting beds of this substance occurring in Eastern Massachusetts. Attempts have been made to compress the peat by a rolling process, but the resulting briquets were not solid enough for locomotive use and broke up too readily. Their heating value is stated to be about 80 per cent. of that of ordinary Pennsylvania bituminous coal. An attempt now is being made to coke the peat."

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Contents.

	PAGE
Some Interesting Things from the Union Iron Works	343
A School Manager on the Metric System	346
Report of the British Weights and Measures Association	346
With the Mechanical Engineers at Liège	351
Some College Shop Experience—III	355
Large Thread-Milling Machine	356
Duane Herbert Church	359
2½- and 3-foot Radial Drill	360
Unfair Treatment of Applicants for Positions	361
Letters to the Editor	361-368
The Manila Electric Railway	368
Franz Reuleaux	368
Professor Reuleaux	370
A Selden Patent Injunction	370
An Alleged New Naval Crime	370
Rum and the "Bennington"	371
Foreign Markets for American Machinery	371
Foreign Envelopes as Office Decorations	372
Changes of Personnel at Purdue	372
New Tools and Machine Shop Appliances	373
Echoes from the Oil Country—A Clean Man in a Machine Shop	374
Personal	375

Professor Reuleaux.

By the death of Prof. Dr. Reuleaux the engineering world loses one of its truly great men. Not merely was Prof. Reuleaux great in the sense of being an expounder of mechanical science and a teacher of it, but along with and above that he was a man of singular nobility of purpose and was actuated by the broadest and highest conception of his duty to himself and to mankind. Never afraid to criticize when he thought criticism was due, he was as ready to praise and to accord honor to others, regardless of nationality or creed. The benefit to mankind resulting from the life and work of Prof. Reuleaux is simply incalculable; his reward is in a modest competence and undying fame. Many a Wall street operator, gambling in the things produced by aid of Prof. Reuleaux's work, makes more money in a day than Prof. Reuleaux accumulated in all his life. But money is not all, and the man who would not prefer to have lived the life of Prof. Reuleaux and to have left behind him Prof. Reuleaux's record of service has no conception of what life is for, nor of what can be made of it.

A Selden Patent Injunction.

Not much has been heard for some time regarding the Selden patent on explosive or internal-combustion engines, applied to automobiles; but it is now announced that Chief Justice Melville W. Fuller, of the United States Circuit Court for the southern district of New York, has issued an injunction against W. J. Moore, prohibiting him from using an imported Martini car. This injunction is issued as a result of an action brought by the Associated Licensed Manufacturers, and it is stated similar injunctions will be asked for against other users of unlicensed cars.

A curious feature of the case is that a prominent New York merchant, dealer in automobiles, has for several years invited the Association of Manufacturers to bring suit against him. He has prominently and strongly advertised a car which is not licensed; has defied the association and its injunctions, and has repeatedly ridiculed its threats to prevent the sale and use of automobiles not licensed under the Selden patent. His advertisement has even contained cartoons of a bogy man, stuffed with straw in the act of attempting to frighten purchasers and users of unlicensed automobiles; and, in fact, every effort seems to have been made by him to tempt the Association of Manufacturers to bring suit, but, so far as we have heard, without result. Naturally, the publication of repeated challenges to bring suit encourages automobile buyers and users in the belief that the association is afraid to bring suit, and has undoubtedly had its effect in encouraging the purchase of unlicensed automobiles; those handled by the merchant in question and others as well. Of course, there may be reasonable and perfectly proper technical reasons for the fact that the repeatedly invited suit has not been brought against the dealer, and that this suit has now been brought against a private user, but the case seems queer, nevertheless. To the man up a tree, these things look like a case of bluff, though until there has been a decision upon the Selden patent by a high court, there is no knowing what the outcome of the matter will be. In August a copy of a French patent was published in the *Horseless Age*, of this city, which patent anticipated the Selden patent by some years and appears to cover the same ground; that is, it is a patent granted for the use of an internal-combustion engine in an automobile. It has been shown, also, that in Providence and in Pittsburg vehicles driven by internal-combustion engines were used some time previous to the date of the Selden patent. These things inevitably have a tendency to strengthen the belief in the minds of many persons that the Association of Licensed Automobile Manufacturers is simply bluffing. But, as stated above, there is no telling what the courts may finally decide, and until there has been such final decision, there will be more or less uncertainty as to what right a manufacturer and a user of automobiles driven by gasolene engines may have. We do not understand that the injunction against Mr. Moore is permanent; it is probably to hold only until the case has been decided in the courts in the regular way.

Since writing the above, we learn that Mr. Moore is a young man who arrived in New York some time ago with a lot of money which he was expeditiously separated from, and that his present stopping place is unknown. The question naturally arises as to why suit was not brought against, say, Frank Gould, who is said to own and operate an exactly similar car, and can be found at any time.

An Alleged New Naval Crime.

A press cable announces that Lord Charles Beresford, commanding the British Mediterranean fleet, has ordered the prosecution by court martial of an engineer commander because the machinery of his vessel had hot bearings. This is declared to be a new naval offense.

Of course, whether it is an offense or not will depend upon the cause of the hot bearings. The hotness might have been due to causes entirely beyond the control of the commanding engineer officer. On the other hand, it might have been due to his neglect; and if the latter, then a penalty therefor would be as appropriate as for a good many other naval offenses.

This reminds us of a locomotive engineer on one of our railway systems. The superintendent of motive power found Jim with his head and shoulders under the boiler, a large "special delivery" oil can in his hand, deluging an eccentric and pouring much more oil upon the ground than upon the machine. The su-

perintendent remonstrated, asking Jim if he knew that oil cost something. Jim took his head out from under the boiler long enough to see who was talking to him, went under again and commenced throwing on more oil, remarking, as he did so, "I don't know just what the oil costs, but I do know that if one of those eccentric straps sticks and breaks it costs me $8."

The road had instituted a system of fines, which it imposed upon its engineers for allowing various things to happen, and Jim had simply made up his mind that that particular thing should not happen on his engine if there was enough oil to prevent it, and as there was no penalty for wasting oil, he was seeing to it that there was enough; "enough," in that case, being all that he could get to stay on the eccentric and strap, and then some more.

Rum and the "Bennington."

A possible explanation of the explosion of boiler "B" on the "Bennington, which we have not seen advanced elsewhere, is offered by the AMERICAN MACHINIST. It says: "What took place seems incompatible with the full possession and command of their faculties by the men concerned, and we are compelled to question if they were sober." Both directly and indirectly the periodical here quoted confirms the view that the duties, the neglect of which immediately preceded the disaster, were among the most common and elementary duties of the men in the boiler-room. According to our contemporary, "any intelligent group of boys from 12 to 15 years of age, who had been around a steam plant and had had an opportunity of observing the procedure followed in raising steam in boilers might reasonably have been expected to have done better than was done in this case."

Here, certainly, is a suggestion which deserves the most careful consideration. In the coming trials of Commander Young and Mr. Wade evidence should be sought which will tend to show whether or not the oiler, fireman and machinist (who were directly responsible for the explosion) were under the influence of liquor on the day when the gunboat was about to leave San Diego for Panama. If survivors cannot indicate with certainty the condition of the three men in question on that particular morning (or the night before), at least it should be feasible to learn whether they were usually abstemious or were addicted to drink. If it should appear that their habits were not above reproach, the simple fact that they were to lose the chance for shore leave for several weeks would excite a suspicion that they had imprudently improved the opportunity for indulgence and had not fully recovered from it at the time of the disaster.

The men whose carelessness is officially regarded as the immediate cause of the explosion are now beyond the reach of human judgment; but if it were shown that they had been habitually intemperate it would follow that a proper oversight had not been exercised by their superiors. Mr. Bonaparte has not indicated specifically the reasons which led him to direct that the commander of the "Bennington" should clear himself from an imputation of laxity in discipline. But if the theory which the AMERICAN MACHINIST feels obliged to entertain should be verified there would be good ground for the Secretary's misgivings.—*New York Tribune.*

Foreign Markets for American Machinery.

A movement is on foot in South Africa to reduce the preference duties granted to British manufactures when imported into that country from the United Kingdom. It is contended that the present tariff has been prejudicial to South African industries, while the South Africans point out that the duty on most classes of machinery is *nil*, and should be increased so as to afford some protection to manufacturing engineers. At present the trade has to import all raw materials, although it is hoped that the Colony will begin to smelt its own ores soon, as there are large deposits all over the country. Local engineering firms are in favor of a duty being imposed. Structural iron work, boilers, etc., and all sections of iron and steel, such as joists, channels, angles, bulls and tees should, they say, be imported at as low a duty as possible, as also bar iron and steel. It is contended by English traders that any increase of duty should be on foreign manufactures, and that British goods should be exempt from any increase. At present American engineering and hardware firms cannot complain of the amount of trade done in the Colony, compared with the value transacted by competing countries. It has been too much the fashion of English houses to depreciate the goods supplied by the United States and Germany. They have not observed the way in which the whole of the tool and file trade has been taken from them. For years England held the supremacy in files, but now it has largely gone to America. The latter has also acquired the mastery in supplying saws, lock furniture, etc.; while the United States manufacturers have always held the lead in edge tools, including axes, shovels, forks, etc.

From more than one quarter comes the complaint that the parts of British machinery are not interchangeable. Some little time ago a British representative was visiting several small industrial works in his district of Bayonne (France), and he made inquiries why British machinery was no longer being employed. He was informed that as regards quality its superiority was indisputable and the prices reasonable, but all the accessories, from the simplest screw or bolt upward were always of a different size or intended to work differently from those made in France; consequently, if the least thing failed, the piece had to be returned to the makers to be refitted, while all accessories of German and Belgian machinery are made after French models.

Those acquainted with the peculiarities of Far Eastern markets are occasionally much amused at the way British and also foreign firms generally set to work to obtain a footing in that direction. For instance, some time ago an English manufacturing house, anxious to open up business with China, got into communication with a respectable local firm of importers, who wrote to the manufacturers calling for the following information: "Literature descriptive of your goods (preferably in leaflet form) suitable for distribution. Your lowest net prices therefor, f. o. b. cash against documents. Freight and insurance charges from the British port to Shanghai, packed and despatched, as you are accustomed to ship abroad. A suitable range of small samples wherewith we could test for opening with probable foreign buyers and through the native travelers, the Chinese market." The importers went on to say that on receipt of this information they could advise the English makers as to: (1) goods (makers) already established here; (2) the prices they are landed at and retailed here; (3) the prospects the importers had of getting a share of the business.

The reply received was substantially to the effect that: (1) the maker's business had been established for 124 years; (2) the highest authority considered their goods of the highest class; (3) their long experience had taught them that samples were of little value; (4) "to show good faith" they wanted a sample order in bulk "for those lines you know can sell." Of course no business resulted. Chinese buyers are not anxious to know how long English firms have been established, and certainly will not give sample orders in bulk for lines of goods they know nothing about, and of which it is considered useless to submit samples. The only way to secure machinery contracts in China is by personal canvassing. The same principles apply in the case of firms wishing to supply government and other establishments with machinery, machine tools, etc. In the majority of cases a price-list is sent to the local Consular representative, with a request that it be handed on to a local agent. But the Chinese Government prefers to deal direct with the manufacturer, and local firms have no facilities for bringing such goods to the immediate notice of the authorities. At Shanghai a machinery agent has published in Chinese a diary illustrated with engravings of the machines for which he acts as agent. It lacks, however, a detailed description of their functions, and until a complete nomenclature in Chinese shall have been drawn up and universally adopted, each translator will invent a name of his own for the com-

ponent parts of an engine, and it will always be difficult to convey to Chinese practical or scientific explanations. A good way to push trade is to take a bright young Chinaman and educate him on commercial lines and in the *technique* of the trade, and then use such a man as traveler. This is how the Japanese have succeeded in their trading operations in China.

London. F. C. C.

Foreign Envelopes as Office Decorations.

Our English contemporary, *The Ironmonger*, develops considerable facetiousness over our account of the office decorations of the Springfield Machine Tool Company (consisting of envelopes received from foreign countries) and discourses upon it as follows:

"The AMERICAN MACHINIST devotes a couple of pages to the illustrated description of a new advertising scheme which reflects credit upon the ingenuity of its inventor. That gentleman is a large machine-tool manufacturer, who has taken special pains in the development of an export trade. What success he has attained is shown by his office walls, for our friend has made it a practice to stick all the envelopes of his foreign letters on the walls of his office. He seems to have begun with the space round his looking-glass, that being possibly the direction in which he naturally turned when musing on the worlds he was conquering. Then his festoonings extended along the four walls, where they form beautiful arabesques and other geometrical designs, until the expansion of his foreign trade forced him to turn his eyes heavenward, possibly out of a feeling of gratitude, but also, I surmise, with a view to estimating the export-trade advertising possibilities of the upper regions.

"One of the photographs in the AMERICAN MACHINIST shows the progress of the attack upon the ceiling. Round the cup of the chandelier revolves an archipelago of envelopes, reminding one of the Philippines, or some other of the recent possessions which Uncle Sam is administering for the good of his "brown brothers" and to the profit of his trusts. If appearances go for anything, the ceiling will soon be full, and the question arises what will our expanding friend do then? We do not know whether he owns his office; but, if he does not, he has placed a terrible weapon in the hands of his landlord, who, if he is half as 'cute as the average Yankee, will no doubt wait until every available bit of space is occupied by an envelope and then raise the rent. Then we shall see a fresh example of the old proverb that the earth is the landlord's, and the fullness thereof."

In this case we can assure our British brother that the office and the ground upon which it stands are owned by the occupant, as, indeed, is almost invariably the case in America, and we believe by no means so invariably true in England.

Changes of Personnel at Purdue.

Prof. W. F. M. Goss, Dean of the Schools of Engineering, Purdue University, informs us of the following changes in the instructional staff of the engineering departments:

C. P. Matthews, M. E., Ph. D., Member American Institute of Electrical Engineers, for several years past Professor of Electrical Engineering, Purdue University, has been appointed Director of the Electrical Laboratory and in charge of the School of Electrical Engineering.

W. O. Teague, B. S., Massachusetts Institute of Technology, Department of Marine Engineering, two years with the Fore River Ship Yard, and one year with the General Electric Company, has been appointed Assistant Professor of Experimental Engineering, in charge of the Engineering Laboratory.

Albert Smith, B. S., Dartmouth, C. E. Thayer School of Engineering, Member of the Western Society of Engineers, has been appointed Assistant Professor of Civil Engineering.

G. A. Young, B. S., M. E., Assistant Professor of Mechanical Engineering, will hereafter be responsible for the direction of the work in thermodynamics.

F. R. Swift, B. S., Massachusetts Institute of Technology, 1901, for two years instructor at the Massachusetts Tech., and more recently with the General Electric Company, has been appointed Instructor in Mechanical Engineering.

O. C. Klipsch, B. S., Purdue University, 1901, since graduating with the Lake Shore & Michigan Southern Railway, has been appointed Instructor in Mechanical Engineering.

Arthur B. Smith, B. S., University of Nebraska, 1901, Associate Member American Institute of Electrical Engineers, for a time Local Manager of Telephone Exchange, Nebraska Telephone Company, Tecumseh, Neb.; afterward Assistant Manager Woodbine Telephone Company, Woodbine, Iowa, and more recently Wire Chief and Engineer, Amsterdam Automatic Telephone Company, Amsterdam, N. Y., has been appointed Instructor in Telephone Engineering.

W. P. Heck, B. S., State College of Pennsylvania, 1904, recently with the Westinghouse Electric Company, has been appointed Assistant in the Engineering Laboratory.

J. W. Swearengen, B. S., Purdue University, 1904, since graduating with the General Electric Company, has been appointed Assistant in the Engineering Laboratory.

H. H. Scofield, M. E., Sibley College, 1905, has been appointed Assistant in the Engineering Laboratory.

H. S. Dickerson, B. S., University of Michigan, 1905, has been appointed Assistant in the Engineering Laboratory.

T. T. Eyre, B. S., Purdue University, 1905, has been appointed Assistant in Machine Design.

G. W. Case, B. S., Purdue University, 1905, has been appointed Assistant in Civil Engineering.

Walter Ackerman, B. S., Purdue University, 1905, has been appointed Assistant in Civil Engineering.

Withdrawals from the staff as organized during the last year are announced as follows:

W. E. Goldsborough, Professor of Electrical Engineering, in charge of the Department; to become Assistant to the President of the J. G. White Company.

J. C. Kelsey, Professor of Telephone Engineering; to go with the Kellogg Switchboard & Supply Company.

G. E. Waesche, Assistant Professor of Civil Engineering; to undertake private work in engineering construction.

J. R. McColl, Associate Professor of Steam Engineering; to take up the work of Chief Engineer for the American Blower Company.

E. E. Reynolds, Associate Professor of Experimental Engineering; to devote himself to personal affairs.

N. J. Wheeler, Assistant in Engineering Laboratory; to become Associate Professor of Civil Engineering, University of Kansas.

R. R. Mitchell, Assistant in the Engineering Laboratory; to go with the Chicago Edison Company.

R. V. Brewster, Assistant in Civil Engineering.

Parker E. Marean, A. M., B. S., Harvard University, has been appointed Research Assistant to W. F. M. Goss, succeeding Aldrich Durant, who has been appointed an Assistant at Harvard University.

The Internationale Pressluft & Elektricitaets Gesellschaft, m. b. H., has been formed to manufacture, in especial, pneumatic and electric tools. The company has obtained the use of important patents on American and English tools, including the Boyer, Little Giant and Keller, and will conduct a business extending over the continent. The headquarters are at 48 Kaiser Wilhelmstrasse, Berlin, C. 2. The directors include Francis E. Drake, Charles G. Eckstein and L. Oberauer.

A company has been formed at Bern, Switzerland, for manufacturing a new kind of combustible from peat. The peat is dried under the influence of electric current and then further treated so that a new compound, known as osmon, is formed. The most recent tests of the new combustible bring out the fact that it burns as well as coal and without giving out any odor or smoke. The per cent. of ash is very small and the fuel does not contain any trace of sulphur.—*The Engineer.*

New Tools and Machine Shop Appliances.

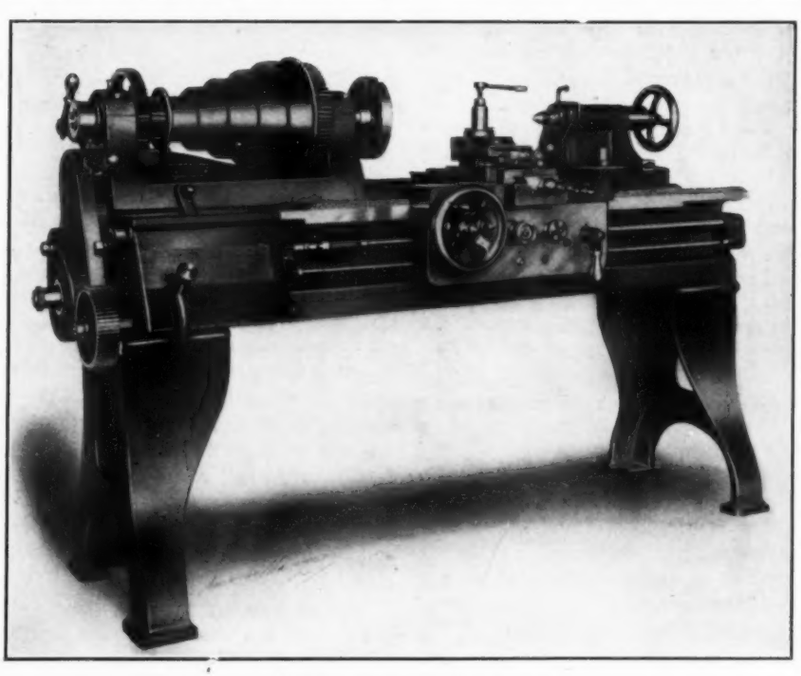
A 16-INCH QUICK-CHANGE LATHE.

The illustration shows a general view of a 16-inch lathe having the change gears so arranged that by moving two levers and a sliding gear fifty-four different feeds —from 7 to 448 per inch—may be obtained, and fifty-four different threads—from 2 to 128 per inch—may be cut.

In a gear box mounted in the front of the lathe are located three shafts, the lower one being the driver, the middle one having gears of various diameters arranged to form a cone, and the top one having three clutch gears of different diameters arranged to mesh with three corresponding gears on the cone shaft.

The lower shaft has teeth cut in it, forming a long pinion which is in mesh at all times with an intermediate gear. This intermediate gear can be thrown into engagement with any one of the cone of gears on the middle shaft. Any one of the clutch gears—three in number —may be thrown into engagement by the top lever in front of the headstock. As there are nine gears on the middle or cone shaft and three on the clutch shaft, this gives twenty-seven changes, which are doubled by means of the slip gear, the nurled handle of which is shown behind the broad-faced gear.

On a 16-inch lathe, threads from 2 to 128 and feeds from 7 to 448 are obtained without the use of change gears; but in case an odd thread or feed is wanted, it is easily obtained by putting the correct gear on the slip gear stud, the sweep being made adjustable to accommodate such changes. Both feed rod and lead screw are provided, the feed rod being driven by the gears, the lead screw by engaging clutches.

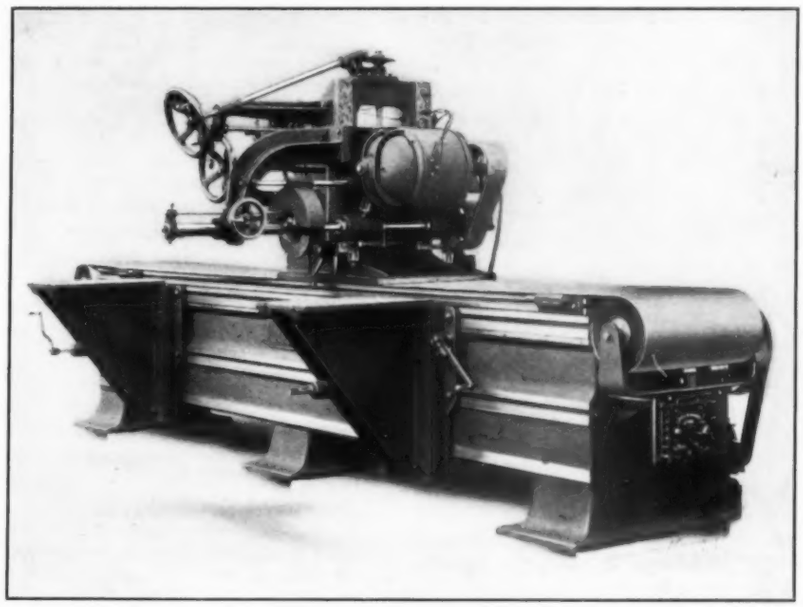


A 16-INCH QUICK-CHANGE LATHE.

Although shown on a 16-inch lathe, this device is being adapted to any of the regular line of lathes from 14 to 28 inches swing built by the makers, Flather & Co., Nashua, N. H.

TRAVERSE GRINDER.

This machine has been designed especially for grinding manganese steel centers of railroad frogs and crossings, and for finishing locomotive crosshead guides, butt ends of connecting rods, etc. It is also adapted to grinding the ways between the V's on lathe beds and for various other purposes. The bed, cast in box form and liberally braced internally, by means of cross girts, is made in varying lengths, the illustration showing one 15 feet long, which permits a longitudinal travel of the saddle, with the wheel, etc., of 12 feet. The saddle is traversed by a 2-horse-power motor through a rack and pinion, at a speed of 15 feet per minute, and is automatically reversed at each end of the stroke, which may be of any length, up to the limit of the machine. The grinding wheel, driven by a 5-horse-power motor at a speed of 1,500 revolutions per minute, has a horizontal movement in the direction of its axis of 15 inches, and a vertical movement of 11½ inches; these movements being controlled one by the hand-wheel attached to the bracket supporting the grinding-wheel shaft and the other by the large hand-wheel whose shaft is set at an angle. The third hand-wheel is for moving the saddle by hand, when desired. The motor is adjustable on the saddle, for the purpose of tightening the belt driving the grinding-wheel shaft. The tables are horizontally adjustable along the bed, by means of a rack and removable ratchet wrench, and vertically by means of a screw, operated by the socket wrenches shown attached to them. A pump and system of piping are provided for supplying water to the grinding wheel, and canvas curtains, also, for protecting the sliding ways on the top of the bed from grit. All controls are located in the saddle; a lever, not visible in the photograph, being provided for reversing the saddle by hand, when desired. The Cincinnati Shaper Company, Cincinnati, Ohio, is the builder.



TRAVERSE GRINDER.

A NEW LINE OF INDUCTION MOTOR.

The Commercial Electric Company, of Indianapolis, Ind., writes us regarding its line of induction motors, on which we published an article at page 296, and says that the range of size of these motors is from .5 to 200 horse-power, not 5 to 20 horse-power, as stated in the article.

Echoes From the Oil Country—A Clean Man in a Machine Shop.

My friend had spent his life in machine shops. He was of a restless disposition and did not stay a great while in any one place. He had filled all sorts of positions, and was full of experiences of one kind or another, but it was only occasionally that he would tell of them.

"I have heard of some of the smart people who can tell all about a man the first look they get at him," said he to me, a little bit sarcastically, "but I am not one of that smart kind. It takes all sorts of people to make a world, and I guess all of the varieties work in machine shops. Did I ever tell you about the way I got fooled once? Well, I will, then, and the same fellow fooled some other folks, too.

"One day an elegant-looking gentleman came walking down through the shop to where I was standing. He was tall and dignified; had on broadcloth, faultlessly polished shoes and a high silk hat. I tried to size him up. He did not look right for a drummer, although I had seen some queer specimens among them. He was not the kind of a man who wanted machinery, and I did not need a doctor or a lawyer. I made up my mind that he was a preacher who wanted to touch me for a contribution. His address corresponded with his apparel.

"'Good morning, sir,' said he, with a courtly wave of his hand. 'I have been informed that you are the superintendent in charge of these works.'

"'I kind of hang around and look after things,' I answered. 'Is there anything I can do for you to-day?'

"'Could you make use of the services of a first-class machinist?' he asked. It all seemed simple enough now. Preachers often tried to hunt up jobs for people who did not seem able to find them for themselves.

"Says I, 'If you know a real good man that you would be willing to hold yourself personally responsible for, I could make use of him.' I thought that I would let him see that I wasn't going to let him unload any bum on me.

"'You can hold me responsible for every statement I make to you. When will you be pleased to have me come to work?'

"I was too much astonished to be polite. I stood and stared at the silk hat and at the shoes, and up along the trousers, and the waistcoat, and the expanse of snowy shirt front, and the smoothly shaven face, to the hat again before I could collect myself enough to speak. It all seemed too far away from life in a machine shop. Perhaps it was a joke of some kind, and I did not yet see it all.

"'You can go to work as soon as you are ready,' said I, thinking to help the matter along.

"'I am very much obliged to you, sir. If you will show me where you wish me to begin and what you would have me to do, I am ready to start.'

"'Not in that rig,' I said, before I thought.

"'Certainly,' he replied, with a cheerful smile; 'this is my regular attire.'

"'You will at least want to get some overclothes,' said I.

"'No,' said he, 'I never wear them. I do not think a man needs to be filthy because he works in a machine shop.'

"'Very well then, just come this way please,' said I. I made up my mind to bring things to a head, and if there was some joke in it, to find out where it was and whom it was on.

"I took him down through the shop to the foreman of the lathe department. The foreman looked somewhat surprised when I told him to put the gentleman to work, but he was used to having to furnish work for all sorts of specimens, and gave him a job and a machine without delay.

"Being somewhat interested myself, I stayed around where I could see how things went. The foreman, influenced by the dignified bearing and new clothes of the newcomer, it may be, shared up his own clothes press with him. The hat, coat, collar and cuffs were removed, and when a handkerchief was tucked about the neck he was ready for business, and the way he centered a shaft and got it into the lathe and got a cut started showed that he was not at all new to the business. His size helped him, and when he straightened up and stood watching the chips roll off, he was as immaculate as ever, except for a little smudge on his hands. Day after day he worked. He did not attempt to make any friends, but always acted to all with whom he came in contact in the same formally polite manner he had shown when looking for the job. Anyone who knows anything about a machine shop can be sure that the men had all sorts of private names for him and all sorts of private explanations as to who he was and why he was working at such a business; but there was something about the man that led them to leave him alone, and if he heard any of the remarks sometimes aimed at him from a distance, he did not give any sign.

"While the men let him alone there was one boy who was not wise enough to do so. This boy was one of those good-natured youngsters who was always doing something which he should not have done, and getting out of it because the men liked him for his good nature and sort of shielded him from one another until he had grown bold.

"The lathe which the man was running stood in such a position that he was facing a large window, which in this warm weather was open. The back of the lathe was several feet from the window, but the space was unoccupied.

"One day there was a long shaft in the lathe and the man was standing erect as a soldier before it with his face to the window. That white shirt had evidently been a source of temptation to the boy who had taken a handful of dirty waste and gone outside of the building and crept up to the window. The nearest door was quite a space away, and he had his plans made to see which way the man started for one and then he intended going the other way. As he looked slyly in at the window he say the man's eyes fixed on the revolving shaft and he let the waste fly. It landed fairly on the snowy shirt front, and not waiting to see what happened the boy took to his heels. I happened along just at this moment and saw it. With a sweep of the hand the shipper was thrown, a jump or vault took him over the shaft in the lathe, and another one took him through the open window, and the next thing we saw was a boy flying wildly down through the shop with a man in pursuit. The boy had the advantage of being familiar with every crook and turn, but the man was too close to let him make full use of his knowledge. He finally dodged through an open door and ran up the street, but his pursuer was soon close after him, and after they had gone about a square he was captured.

"'Boy,' said the man, 'we will go either to the police station or back to the company's office where you can make arrangements to replace this shirt with a new one. Which place do you prefer?'

"The boy thought he would prefer the office and they went back, the man with a firm grasp on the boy. They went into the office.

"'Gentlemen, this boy through a little misapplied energy has spoiled a shirt for me. If he can make the financial arrangements necessary to replace it the matter ends as far as I am concerned,' and the gentleman bowed politely. The boy had to make his own explanation as best he could, and finally settled the matter by paying for a tailor-made shirt and for the time the man lost in catching him, and in going and changing into a clean shirt.

"No, we did not discharge the boy. His mother was a widow, and he was a pretty good boy in a general way, and we thought he had received a very good lesson, even if it was a bit expensive. I left the place shortly after that and do not know what became of the man. He was working there when I came away,

and still worked without overalls. He was the only man that I ever knew who could keep really clean around a machine shop. I know that the boss of the lathe gang did not give him the dirty jobs, but even with the cleanest jobs I could not see how he kept so clean."

Most of us are willing to say we think we have seen the dirtiest man that ever worked in a machine shop, but I for one have never seen one as clean as this one my friend told me about.

W. OSBORNE.

Personal.

A. H. Valiquette, formerly with the Rand Drill Company, of Pittsburg, has accepted the position of Eastern representative of the Blaisdell Machinery Company, of Bradford, with headquarters in New York city.

Emil Grossman, who has been prominently connected with the automobile business, is president of the recently organized National Sales Corporation, which has offices at 256 Broadway, and which will devote its attention to the marketing of various manufactured products. Associated with him is E. J. Kuegeman, who will be general manager, and was formerly the sales manager of the Auto Brass & Aluminum Company, of Flint, Michigan.

Forrest R. Jones, M. E., well known among mechanical engineers, and Edward J. Kunze, M. E., also a Cornell University graduate and an expert in oil and gas engines, have organized the Manhattan Automobile School, 315 West Ninety-sixth street, New York, and in this school it is intended to give practical instruction in the management of automobiles of all kinds, instruction being adapted both for owners and for mechanicians.

It is announced that Walter H. Whiteside is to be the new president of the Allis-Chalmers Company. Mr. Whiteside has been vice-president of the company for some time, and during Mr. Warren's absence has been in charge of its affairs. His success has been such as to make him the logical successor of Mr. Warren. Mr. Whiteside is still quite a young man, his business career having commenced in 1881. He has been connected with various well-known manufacturing concerns, having been manager of engine sales for the Gates Iron Works, of Chicago, and a district manager of the Westinghouse Electric & Manufacturing Company. He was also general manager of the Sawyer-Mann Electric Company, of New York.

Business Items.

The Hercules Gas Engine Works, San Francisco, Cal., which were recently destroyed by fire, have resumed operations and will continue to manufacture their well-known line of engines. The company has on hand, in its various agencies, a full line of engines from which to fill current orders.

Owing to improved facilities for manufacturing, the Tabor Manufacturing Company, Philadelphia, Pa., has decided to make a reduction in the price of Taylor-Newbold saws. This change in price takes effect on all orders placed after August 1, 1905; but it does not affect any business already in hand at that time.

F. N. Gardner, well known as the inventor of the Gardner disk grinder, the Gardner die head and other mechanical devices, having organized the Gardner Machine Company at Beloit, Wis., is arranging to bring out a line of improved Gardner disk grinders, and may introduce some other new things in the way of machine shop equipment.

The Toledo Machine & Tool Company, of Toledo, O., reports a brisk demand for its line of punch presses. The company has recently been doing considerable export business. A large shipment has just gone forward to Hamburg, Germany; another large shipment has been shipped to Denmark, and the company is working on a large order for England.

Three of the new roundhouses of the Erie Railroad are to be equipped by the B. F. Sturtevant Company, of Boston, Mass., with complete systems of heating and ventilation, particularly applied for thawing out engines during the winter. These include a ten-stall house at Marion, O.; a fourteen-stall house at Kent, O., and a ten-stall house at Hammond, Ind. The New York Fire Department repair shops are also to be equipped by the B. F. Sturtevant Company with a complete outfit of forges, blowers and a smoke-exhauster.

The London branch of the Buffalo Forge Company has procured a very interesting order for heating and ventilating the various buildings of His Majesty's dock yards at Portsmouth. There are seven separate plants, each involving the same capacity of apparatus and of large size. The engineers of the Buffalo Forge Company's London office, in studying the requirements and existing conditions of the buildings, decided upon the use of fans especially designed therefor. Likewise the fifty-six heaters to be used in the installation are of special construction.

The Erie Railroad Company has awarded the following contracts to the Buffalo Forge Company, Buffalo, N. Y.: Buffalo fan system heating and ventilating outfit for its forty-two-stall roundhouse at Buffalo, N. Y., requiring Buffalo steel plate 220-inch fan with belt-connected 75 horse-power motor, and heater containing fifteen four-row sections, each section 6 feet by 8 feet 4 inches. Buffalo fan system heating and ventilating outfit for its forty-three-stall roundhouse at Hornellsville, N. Y.; requiring Buffalo steel plate 210-inch fan with belt-connected 60 horse-power motor, and heater containing twenty two-row sections, each section 7 feet by 9 feet 4 inches. Buffalo fan system heating and ventilating outfit for its twenty-one-stall roundhouse at Galion, O.; requiring Buffalo steel plate 150-inch fan with direct-connected 8x10 Buffalo engine, and heater containing ten four-row sections, each section 5 feet by 6 feet 10 inches. Buffalo fan system heating and ventilating outfit for its twenty-one-stall roundhouse at Huntington, Ind.; requiring Buffalo steel plate 150-inch fan with direct-connected 8x10 Buffalo engine, and heater containing twelve four-row sections, each section 5 feet by 6 feet 10 inches. If the pipe alone used in these heaters were laid in single continuous length, the distance covered would be practically 6½ miles.

Manufacturers.

The Youngstown (O.) Bolt Company is rebuilding its plant.

The Columbus (O.) Granite Brick Company is erecting a new plant.

The Roxbury (Md.) Distilling Company is erecting a large new warehouse.

The paper mill of Stowe Bros., Scitico, Conn., was burned; loss, $20,000.

The Nebraska Seed Company, Omaha, Neb., will erect a new brick warehouse.

The Kingman Plow Company, Peoria, Ill., will build an addition to its plant.

The Rowbottom Machine Company, Waterville, Conn., is extending its plant.

The Pepperell Company, at Biddeford, Me., is to install an electric light plant.

The Jackson (Tenn.) Woolen Mills were burned, entailing a loss of $100,000.

Newton & Davis, Royalston, Mass., will rebuild their sawmill, recently burned.

The Economy Culvert Company, Crawfordsville, Ind., will move to Auburn, N. Y.

The New York Central has commenced work on new car shops at Minoa, N. Y.

A large addition is being built to the Farnsworth flannel mill, at Lisbon Center, Me.

Houston, Stanwood & Gamble, engine builders, Covington, Ky., will enlarge their plant.

The Pennsylvania Tube Company, Philadelphia, Pa., will erect a plant at South Monaca, Pa.

The Illinois Central Railroad will spend $300,000 in enlarging its shops at Burnside, Ill.

The Standard Upholstering Company, of Abilene, Kan., will move its factory to Topeka.

The Western Tool & Manufacturing Company, Springfield, O., intends to erect a new plant.

John H. Adams, manufacturer of dies, Worcester, Mass., will make an addition to his factory.

The Helmschmeid Manufacturing Company, Meriden, Conn., glassware, will erect a new factory.

The Brooks Boat Manufacturing Company, of Bay City, Mich., is looking for another location.

The George Urban Milling Company, Buffalo, N. Y., will build an addition, to cost $15,000.

The tannery plant of Henry Holliner, Columbia, Pa., was destroyed by fire; loss, $100,000.

The Marshall (Mich.) Harrow & Manufacturing Company, a new company, will erect a factory.

The Warner & Swasey Company, Cleveland, O., will erect a new factory building, to cost $50,000.

Chas. Besly & Co., Chicago, Ill., brass goods, etc., has let contract for its new plant in Beloit, Wis.

The Coulson Poultry & Stock Food Company, Petaluma, Cal., is planning to establish a factory in Omaha.

Henry Keller, Sauk Center, Minn., will erect a wagon factory in Minneapolis which will employ 300 men.

The Great Western Stove Company, Leavenworth, Kan., will erect a large warehouse in Oklahoma City, Okla.

Plans have been distributed by the Baltimore & Ohio Railroad for the machine shops to be erected at Westport.

A cold storage plant, to cost $30,000, will be erected in Missoula, Mont. P. M. Reilly, of that place, is interested.

The Triumph Safe & Lock Company, Connersville, Ind., recently incorporated, has closed contract for a factory.

The Peck, Stow & Wilcox Company, Southington, Conn., hardware, is putting up an addition to its plant, to be used for plating purposes largely.

The John Hoberg Company, Green Bay, Wis., is planning to build a $25,000 addition to its plant, in the shape of a boiler-house and a warehouse.

The Westinghouse interests have bought a site on the Niagara frontier on which they will build a large plant for the manufacture of electrical machinery.

The St. Paul (Minn.) Gas Light Company will erect a $35,000 addition, to be used as a boiler-room, and which will be equipped with all the latest devices.

The Bovaird & Seyfang Manufacturing Company, Bradford, Pa., has commenced the erection of a new plant for the manufacture of its oil-well tools and boilers.

The J. H. Sessions & Sons Company, Bristol, Conn., manufacturing small hardware, etc., has been incorporated and, it is understood, will erect a new factory.

The International Red Cross Cream Separator Company has been organiezd at Berwick, Me. Capital, $50,000. Chas. F. Richards, of Portsmouth, N. H., president.

L. J. Coburn, of the Coburn Land & Lumber Company, New Britain, Conn., has purchased land in Gardner, Mass., on which he will erect a factory for hardware specialties.

The H. Wales Lines Company, Meriden, Conn., has closed contract with the Continental Iron & Steel Company for the erection of six factory buildings at Rahway, N. J., to cost $100,000.

Phillips & Bartlett, of Deadwood, S. D., have received the $22,000 contract from the Consolidated Power & Light Company, of South Dakota, to build its new power-house at Pluma.

Charles Gilpin, Baltimore, Md., is estimating on a foundry, machine shop and a pattern shop, to be erected at Elkins, W. Va., for the Humphrey Manufacturing Company. The structure will be two stories and will have a floor space 123x82 feet.

The Aberdeen Sawmill, Fredericton, N. B., with all the buildings and machinery connected therewith and some 10,000,000 feet of lumber, was destroyed by fire. The loss is estimated at between $150,000 and $200,000, with about $60,000 insurance.

It is stated that the Bristol (Va.) Gas & Electric Company will expend about $100,000 for the improvement and enlargement of its plant. The General Electric Company, of Schenectady, N. Y., is said to have recently bought control of the Bristol Company.

The Detroit (Mich.) Steel Castings Company is rebuilding its plant, which burned to the ground six months ago, and is doubling the capacity of the original plant. The new buildings are of steel and concrete and considered absolutely fireproof. The plant expects to be again doing business by January 1.

Proposals will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until 10 o'clock A. M., September 12, 1905, and publicly opened immediately thereafter, for the construction of a power-house, about 71 feet 2 inches long by 34 feet 2 inches wide, on the grounds of the United States Naval Medical School, Washington, D. C. Copies of plans can be obtained upon application to the Bureau of Medicine and Surgery, Navy Department, Washington, D. C. Applications for proposals should refer to Schedule 107. Blank proposals will be furnished upon application to the bureau.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Factories and special machines designed. James F. Hobart, 66 70th st., Brooklyn, N. Y.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Wanted—24 or 28 in. geared shaper; second hand; good condition. Address Shartle Bros. Machine Company, Middletown, Ohio.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Brown & Sharpe screw machine cams, designed by experts, will greatly increase production. Send sample or sketch for estimate. Box 761, Waterbury, Conn.

Turbine expert and engineer will communicate with well-equipped shop, in view of manufacturing a variable steam turbine. Box 570, AMERICAN MACHINIST.

Shop Economics!—Interested? See September *Marine Engineering*, and let me know if a competent man can be useful to you. Lucas, 120 Meserole ave., Brooklyn.

Have attractive idea, promising entirely new line and big rewards; desire co-operation of mechanical engineer with sufficient capital to advance same. Box 574, AMER. MACH.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Manufacturers' Agents.—We are prepared and desire to represent manufacturers of devices new in this territory. G. S. Carter Machinery Co., 225 North First st., Minneapolis, Minn.

Incorporation of mechanical industries, and other legal matters relating thereto, specialized. Correspondence solicited. Send for references. Fred'k P. Schenck, N. Y. and N. J. Counselor, 141 Broadway, New York.

A Liverpool, England, commission agent wishes an additional agency to work with present lines; 26 years' connection among ironmongers, contractors, etc.; understands import and distribution of goods; could handle American goods to advantage in the United Kingdom; references furnished and required. Reply to Box 573, AMER. MACH.

For Sale.

New Tabor indicator for sale; cheap. Address "Tabor," 323 W. 124th st., New York.

For Sale—One 75 H.-P. tubular boiler, 5x 13 ft., in good condition; also one marble grinder, complete, with gears, chain elevator, etc. Box 566, AMERICAN MACHINIST.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

The complete course in civil engineering, including about 12 bound volumes, as given by the International Correspondence Schools of Scranton, Pa. "Education," care AM. MACH.

For Sale—A quantity of Hermann Boker flat steel, all thin, ¼ to 1 in. width; also a quantity of Phoenix drill rod, sizes 15-55; all will be sold very cheap if entire quantity can be closed out. Address Box 581, AM. M.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

GEORGIA.

Wanted—Position, by young man, as general foreman or superintendent; experienced in repair work, gas engine, steam engine, ice machinery and general jobbing; competent to make estimates, design new work, design special tools and to systematize a shop in an up-to-date manner; have successfully designed an air-cooled gas engine of stationary type up to 6 H.-P.; am at present holding position as superintendent; can give excellent references; good reason for wanting to change. Address Box 575, AMERICAN MACHINIST.

ILLINOIS.

Mechanical draftsman, age 32, technically educated, 5 years' drafting and 7 years' machine shop experience, would like to secure a position, preferably as assistant superintendent in some up-to-date shop. Address Box 586, AMERICAN MACHINIST.

MASSACHUSETTS.

Experienced and successful writer on mechanical subjects, illustrates own work, member A. S. M. E., desires position with firm requiring such services; best references. Box 579, AMERICAN MACHINIST.

Machine shop superintendent desires change; member A. S. M. E.; A1 mechanic; good designer; up-to-date modern methods, cost systems, and successful in handling men. Box 580, AMERICAN MACHINIST.

Wanted—Position as superintendent, by a practical, up-to-date man, thoroughly familiar with the latest shop methods; 12 years' experience in charge of help; am employed; best of references to those who desire the services of a hustler. Box 553, AM. MACH.

NEW JERSEY.

Toolmaker, experienced; cutters, jigs, fixtures, machine tool repairs. Box 552, A. M.

NEW YORK.

Mechanical draftsman wishes position. Address Box 587, AMERICAN MACHINIST.

Mechanical draftsman, experienced on automatic machinery and automobiles, wants position. Box 572, AMERICAN MACHINIST.

Position as foreman or superintendent of machine shop, drop forge plant or stamped metal goods. Address "General Foreman," care AMERICAN MACHINIST.

Foreman, thorough mechanic, age 29, inventive and executive ability, desires change; steam or gas engines preferred. Address Box 583, AMERICAN MACHINIST.

Expert, progressive mechanic, 20 years' experience, 7 years foreman, wants position, foreman or master mechanic. Address Box 585, AMERICAN MACHINIST.

Competent mechanical engineer, 8 years' experience, desires position as chief or assistant; pumping machinery preferred; references. Box 588, AMERICAN MACHINIST.

An up-to-date toolmaker and draftsman wishes a position to take charge of toolroom and design tools; New England preferred. Address Box 569, AMERICAN MACHINIST.

Foreman machinist, practical mechanic of varied experience, college and drafting-room training, desires position as shop foreman or assistant superintendent. Box 577, AM. M.

Young man, 33 years of age, with 3 years' technical education, 7 years' shop and 7 years' drawing-room experience, wants position as draftsman; best of references in regard to general machine work, hoisting machines, pumps and special machinery. Address Box 571, AMERICAN MACHINIST.

OHIO.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

PENNSYLVANIA.

Mechanical draftsman, technical graduate, 4 years' experience, shop and office, wishes position; Eastern locality preferred. Address "F. G. M.," care AMERICAN MACHINIST.

An educated mechanic and business man, with 7 years' experience as toolmaker and machinist, afterward scientific course at university and 3 years' executive experience with the large metal-stamping concern where he learned his trade, would like to correspond with parties requiring a technical executive. Box 507, AMERICAN MACHINIST.

VERMONT.

Master Mechanic.—Young man with technical training and 5 years' practical experience, now employed as assistant to master mechanic of paper mill, desires position as master mechanic of a similar plant. "Mechanic," care AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class toolmakers for bending, forming and sub-press dies; state experience and wages wanted. Ross Rifle Co., Quebec, Canada.

Wanted—First-class general foreman for wire insulating factory in Canada, where rubber covered weather proof, magnet and general insulated wires are made; state wages and experience. Box 564, AMERICAN MACHINIST.

ILLINOIS.

Feed and speed foreman for a machine shop employing 75 machinists on large and small

machine tools; man with energy and aggressiveness wanted; state age, past experience and salary desired. Box 567, AMER. MACH.

Wanted—First-class man, capable of taking charge of automatic gear cutter and milling machines, on general job work; must understand bevel, spiral and worm gear cutting; first-class references required. Box 556, AMERICAN MACHINIST.

Wanted—Man for forge department, by large manufacturing concern; must be a competent drop forge die and tool designer, thoroughly posted on modern shop methods, with ability to handle men; an exceptionally good opening for the right man; no attention paid to applicants who do not state age, salary expected and full particulars regarding experience. Box 568, AMERICAN MACHINIST.

INDIANA.

Wanted—Machinist; a first-class man as fitter on screw machines. Box 392, AM. M.

Wanted—A mechanical engineer; must be well versed in steam engineering, electrical work, machine shop practice, machine designing, wood and iron working machinery, and general maintenance of a large manufacturing plant; give details of experience and education. Studebaker Bros. Mfg. Co., South Bend, Ind.

MASSACHUSETTS.

Wanted—Young man, experienced in gear work, for office and shop assistant. Boston Gear Works, Boston, Mass.

Wanted—Assistant superintendent and inspector, experienced in gear cutting job shop. Address, with full particulars, Boston Gear Works, Boston, Mass.

MICHIGAN.

Draftsman wanted, for checking drawings and assisting chief draftsman, by large automobile company located in Detroit; he must be somewhat familiar with gasolene engines and automobiles and thoroughly familiar with tool designing for manufacturing on interchangeable plan; permanent position for right person; give full particulars, including wages expected and references. Box 584, AM. M.

Wanted—Immediately, several toolmakers; men who have had experience making jigs, fixtures and tools adapted to manufacturing parts of accurate machinery on the interchangeable plan, by modern machinery and appliances. (If you have not had such experience, please do not answer this advertisement.) To experienced and competent men, of good character, who can secure results, steady work and attractive wages; state age, qualifications, references. Cadillac Automobile Company, Employment Bureau, Detroit, Mich.

NEW HAMPSHIRE.

Wanted—Draftsman, designing and detailing; machinery and steam engines; give experience, references and pay expected. Address Box 582, AMERICAN MACHINIST.

NEW JERSEY.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Wanted—An assistant superintendent for a machine shop near Philadelphia, employing about 400 hands, on small interchangeable work; a thoroughly systematic man, experienced in the handling of men, who can produce, economically, duplicate work in large quantities, without excuses, is required; do not apply if you are not worth $3,000 per year to us; applicants are requested to state where now employed, length of time of such employment, age, references and qualifications for this position. Address Box 540, AM. M.

NEW YORK.

Wanted—Experienced toolmakers. Address Imperial Engine Co., Painted Post, N. Y.

Wanted—Draftsman, experienced in jig and fixture work; good position. Address "H. Mfg. Co.," care AMERICAN MACHINIST.

Good automobile draftsman wanted; must understand English; give age, outline experience and state wages. Box 576, AM. MACH.

Wanted—First-class designer on dies and tools for interchangeable work; state experience and terms. Box 565, AMER. MACHINIST.

Wanted—Lathe hands for day and night shift; steady positions assured to sober, industrious men. Address, with references, Imperial Engine Co., Painted Post, N. Y.

Wanted—Several A1 mechanical draftsmen; only those having had 3 or more years' practical experience need apply. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted—Day and night foremen for machine department, capable of producing the best possible results with modern tools; good positions for men willing to show results; state age, experience and give references. Box 534, AMERICAN MACHINIST.

Wanted—Superintendent with experience in the manufacture of first-class machine tools; must be energetic, with good executive ability; technical graduate preferred; an excellent opportunity for the right man; state age and past experience. Address "Machinery Manufacturer," care AMER. MACHINIST.

OHIO.

Wanted—Detail draftsman, familiar with heavy engine work. Address The Wm. Tod Co., Youngstown, Ohio.

Draftsman wanted; technical graduate with some experience; steady man, willing to learn. Address P. O. Box 876, Cincinnati, O.

PENNSYLVANIA.

Wanted—Operators for bevel gear planers. Fawcus Machine Co., Pittsburg, Pa.

Wanted—A few first-class, all-around machinists. Storage Battery Department, The Westinghouse Machine Company, East Pittsburg, Pa.

Wanted—Draftsman, thoroughly experienced in designing machines for heavy gear cutting; state salary expected. Box 563, AMERICAN MACHINIST.

Wanted—In southern Pennsylvania, a mechanical draftsman and designer, familiar with machine shop practice, for machine tool work; in reply, state experience, references and wages wanted. Box 548, AMER. MACH.

Foreman to take charge of modern equipped machine shop; 100 men; must be accustomed to modern methods of rapid production in a miscellaneous class of work; reply promptly, giving age, experience and salary expected. Address "X. Y.," care AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Wanted—A practical machinist to manufacture a steam specialty of high merit. Address P. O. Box 52, St. Paul, Minn.

WISCONSIN.

Wanted—Two mechanical draftsmen; must be experienced in steam pump work. Address, giving references and wages expected, Box 578, AMERICAN MACHINIST.

Machinists Wanted.—We have a few good jobs for first-class men. Write, giving full particulars about experience, etc., to the Northern Electrical Mfg. Co., Madison, Wis.

FOREIGN.

Draftsman.—Wanted, by a large German tool-making concern, a smart draftsman, thoroughly conversant with automatic screw machines and turret lathes; applicant must be a specialist and thoroughly capable of independently designing these machines and the necessary tools; the position is a permanent one, and a good salary will be paid to first-class man, but none other need apply; knowledge of German not necessary. Apply, under F-874, to D. Schürmann, Advertising Office, Düsseldorf, Germany.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	101
Acme Machinery Co.	34
Adams Co., The	33
Albro-Clem Elevator Co.	96
Allen, John F.	92
Allington & Curtis Mfg. Co.	101
Almond Mfg. Co., T. R.	94
American Gas Furnace Co.	14
American Pulley Co.	84
American Tool & Mach. Co.	108
American Tool Works Co.	8
American Tube & Stamping Co.	24
Armstrong Bros. Tool Co.	30
Auburn Ball Bearing Co.	101
Aurora Tool Works	30
Automatic Machine Co.	106
Baird Machinery Co.	90
Baker Brothers	104
Baldwin Chain & Mfg. Co.	98
Baldwin Steel Co.	102
Ball Bearing Co.	34
Barnes Co., B. F.	106
Barnes Co., W. F. & John	14
Barnett Co., G. & H.	4th Cover
Bartlett, E. E.	100
Bay State Stamping Co.	109
Bay State Tap & Die Co.	91
Beaman & Smith Co., The	15 and 94
Becker-Brainard Milling Machine Co.	13
Bertram & Sons Co., Ltd., John	14
Besly & Co., Chas. H.	16
Bethlehem Fdry. & Mach. Co.	89
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	95
Bilgram, Hugo	34
Billings & Spencer Co.	24
Binsse Machine Co.	34
Birdsboro Steel Foundry & Machine Co.	105
Blaisdell Machinery Co.	93
Blanchard Mach. Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	22
Boker & Co., Hermann	83
Boston Gear Works	96
Boynton & Plummer	109
Bradford Machine Tool Co.	5
Bridgeford Mach. Tool Wks.	33
Bristol Co.	4th Cover
Brown-Cochran Co.	108
Brown & Co., R. H.	94
Brown & Sharpe Mfg. Co.	73 and 4th Cover
Brown Hoisting Mach. Co.	100
Buffalo Forge Co.	4th Cover
Builders Iron Foundry	3d Cover
Bullard Auto. Wrench Co.	101
Bullard Machine Tool Co.	32 and 101
Butler, A. G.	109
Caldwell & Son Co., H. W.	98
Carborundum Co., The	20
Card Mfg. Co., S. W.	17
Carpenter Tap & Die Co., J. M.	98
Case Mfg. Co.	100
C & C Electric Co.	27
Chambersburg Engr. Co.	92
Chattanooga Machinery Co.	101
Chicago Rawhide Mfg. Co.	96
Christensen, N. A.	95
Cincinnati Machine Tool Co.	29
Cincinnati Milling Mach. Co.	6 and 7
Cincinnati Planer Co.	9
Cincinnati Shaper Co.	110
Clark Cast Steel Cement Co.	106
Clark, Jr., & Co., Jas.	95
Cleveland Auto. Mach. Co.	18
Cleveland Crane & Car Co.	100
Cleveland Pneumatic Tool Co.	92
Cleveland Twist Drill Co., The	4th Cover
Clough, R. M.	96
Coates Clipper Mfg. Co.	108
Coes Wrench Co.	23
Colburn Machine Tool Co.	22
Columbus Machine Co.	108
Cook Co., Asa S.	101
Crane Co.	109
Crescent Forgings Co.	24
Cresson Co., Geo. V.	95
Crocker-Wheeler Co.	27
Crosby Steam Gage & Valve Co.	17
Cumberland Steel Co.	92
Curtis & Co. Mfg. Co.	92
Curtis & Curtis Co.	30
Cushman Chuck Co.	94
Cutler-Hammer Clutch Co.	28
Dallett Co., Thomas H.	105
Davis, Rodney	96
Desmond-Stephan Mfg. Co.	103
Detrick & Harvey Mach. Co.	30
Diamond Machine Co.	3d Cover
Dill Machine Co., T. C.	22
Dixon Crucible Co., Joseph	109
Draper Machine Tool Co.	22
Dreses Machine Tool Co.	91
Druckleb, C.	92
Dwight Slate Mach. Co.	97
Earle Gear & Mach. Co.	96
Eberhardt Bros. Machine Co.	96
Eck Dynamo & Motor Wks.	28
Electro-Dynamic Co.	29
Erie Forge Co.	87
Errington, F. A.	95
Evans Friction Cone Co.	28
Excelsior Needle Co.	98
Fairbanks Co.	87 and 89
Farrel Fdry. & Machine Co.	102
Fawcus Machine Co.	98
Fellows Gear Shaper Co.	96
Fenn-Sadler Machine Co.	103
Field, Chas. H.	28
Firth-Stirling Steel Co.	102
Fitchburg Machine Works	16
Foos Gas Engine Co.	108
Fosdick Machine Tool Co.	15
Franklin Mfg. Co.	31
Garvin Machine Co., The	91
Geier Co., P. A.	96
General Electric Co.	26
General Mfg. Co.	98
General Pneumatic Tool Co.	25
Geometric Tool Co.	29
Gilmore Electric Co.	28
Gleason Works	4th Cover
Goldschmidt Thermit Co.	103
Gorton Machine Co., Geo.	100
Gould & Eberhardt	77
Graham Mfg. Co.	107
Grant Gear Works	96
Gray & Prior Mach. Co.	102
Gray Co., G. A.	34
Greaves, Klusman & Co.	101
Greenfield Machine Co.	107
Greenwald Co., I. & E.	96
Hammacher, Schlemmer & Co.	79
Hampden Corundum Wheel Co.	94
Harrington, Son & Co., Inc., Edw.	25
Hartford Steam Boiler Insp. & Ins. Co.	108
Hendey Machine Co.	81
Henley Publishing Co., Norman W.	85
Henry & Wright Mfg. Co.	30
Heppenstall Forge & Knife Co.	98
Herron & Bury Mfg. Co.	92
Hess-Bright Mfg. Co.	100
Hill, Clarke & Co.	90
Hill-Standard Mfg. Co.	98
Hilles & Jones Co.	90
Hisey-Wolf Machine Co.	101
Hoefer Mfg. Co.	14
Hoggson & Pettis Mfg. Co.	94
Horsburgh & Scott Co.	4th Cover
Horton & Son Co., E.	94
Hunt Co., C. W.	100
Hunt & Co., Robt. W.	108
Hyatt Roller Bearing Co.	100
Ingalls & Co.	30
Ingersoll Milling Mach. Co.	108
Ingersoll-Sergeant Drill Co.	93
International Specialty Co.	103
Iroquois Machine Co.	30

PAGE

Jacobs Mfg. Co. 94
Jacobson Mach. Mfg. Co. 108
Jantz & Leist Electric Co. 28
Jeffrey Mfg. Co., The 88
Jenkins Brothers 109
Johnson Machine Co., Carlyle. 84
Jones & Lamson Machine Co.. 12 and 34

Kent & Co., Edwin R. 102
Keystone Watch Case Co. ..... 88 and 90
Kilbourne & Jacobs Mfg. Co. . 102
King Machine Tool Co. 30

Landis Machine Co. 104
Landis Tool Co. 75
Lapointe Machine Tool Co. ... 107
Le Blond Machine Tool Co., R. K. ..... 4th Cover
Le Count, Wm. G. 94
Link-Belt Engineering Co. 79
Lockwood, Arthur J. 103
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co., The ... 104
Lucas, J. L. 88
Lunkenheimer Co., The 109

McCabe, J. J. ..... 88 and 104
McDowell, Stocker & Co. 90
McGlehan & Co., C. H. 94
McInnes Steel Co. 102
Maris Bros. 100
Marshall & Huschart Mch. Co. 89
Massachusetts Saw Works. ... 108
Massey Machine Co. 31
Mechanical Accountant Co. ... 98
Merrell Mfg. Co. 101
Merritt & Co. 95
Mietz Iron Fdry. & Mach. Works, August. 108
Millers Falls Co. 103
Miner & Peck Mfg. Co. 108
Moore Co., Franklin. 93
Morse Chain Co. 106
Morse Twist Drill & Mach. Co. 33
Morse, Williams & Co. 97

PAGE

Motch & Merryweather Mchry. Co. 89
Mueller Mach. Tool Co. 101

National-Acme Mfg. Co. 110
National Corundum Wheel Co. 106
New Britain Machine Co. ... 109
New Era Gas Engine Co. 108
New Haven Mfg. Co. 106
New Process Raw Hide Co. .. 97
New Process Twist Drill Co. . 105
Newton Mach. Tool Wks., Inc. 11
Nicholson File Co. 17
Nicholson & Co., W. H. 105
Niles-Bement-Pond Co. ..... 88, 90, 111, 112, 113 and 114
Northern Electrical Mfg. Co. 26
Northern Engineering Works. 100
Norton Emery Wheel Co. 84
Norton Grinding Co. 9
Nuttall Co., R. D. 96
Nutter, Barnes & Co. 106

Obermayer Co., S. 109
O. K. Tool Holder Co. 85
Owen Machine Tool Co. 101

Parker Co., Chas. 107
Patterson, Gottfried & Hunter, Ltd. 84
Pawling & Harnischfeger 100
Paxson Co., J. W. 109
Philadelphia Bourse. 106
Philadelphia Gear Works. ... 96
Phillips & Sons Co., F. R. ... 95
Phoenix Mfg. Co. 22
Poole Co., J. Morton. 107
Potter & Johnston Mach. Co. 81
Pratt Chuck Co. 94
Pratt & Whitney Co. ... 2 and 3
Prentiss Tool & Supply Co... 1 and 88
Prentiss Vise Co. 107

Rand Drill Co. 92
Ransom Mfg. Co. 98
Reed Mfg. Co. 107

PAGE

Reeves Pulley Co. 100
Reichheim & Co., E. P. . 4th Cover
Reliance Machine & Tool Co. 108
Rivett-Dock Co. ..... 3d Cover
Rivett Lathe. ..... 3d Cover
Robbins, L. 102
Rogers, Boat, Gage & Drill Works, John M. 25
Rotary File & Machine Co. . 109
Rowbottom Machine Co. 103

Safety Emery Wheel Co. 107
Saunders' Sons, D. 95
Sawyer Gear Works. 96
Schieren & Co., Chas. A. 100
Schumacher & Boye. 9
Schwerdtle Stamp Co. 108
Scranton & Co. 96
Sebastian Lathe Co. 104
Sellers & Co., Inc., William. . 34
Seneca Falls Mfg. Co. 24
Shelby Steel Tube Co. 102
Shultz Belting Co. 107
Sibley Machine Tool Co. 101
Silk Machine Tool Co., P. P. . 98
Simonds Mfg. Co. 97
Skinner Chuck Co. 94
Slocomb Co., J. T. 105
Smith & Mills. 103
Speed Changing Pulley Co. . . 100
Sprague Electric Co. 26
Springfield Machine Tool Co. . 16
Standard Engineering Works. 103
Standard Gauge Steel Co. 98
Standard Tool Co. 85
Standard Welding Co. 85
Stanley G. I. Elec. Mfg. Co. . 87
Stark Tool Co. 107
Starrett Co., L. S. 83
Steptoe Shaper Co., John. ... 108
Stoever Fdry. & Mfg. Co. 107
Struthers-Wells Co. 108
Sturtevant Co., B. F. 23
Syracuse Raw Hide Co. 97

Taylor-Wilson Mfg. Co. 96
Three Rivers Tool Co. 14
Toledo Machine & Tool Co. ... 104

PAGE

Toomey, Frank. 88
Triumph Electric Co. 28
Trump Brothers Machine Co. 94

Underwood & Co., H. B. 103
Union Drawn Steel Co. 102
Union Twist Drill Co. 77
U. S. Foundry & Sales Co. ... 102

Vandyck Churchill Co. 19
Veeder Mfg. Co. 106
Vickers, Sons & Maxim. 103
Vitrified Wheel Co. 85

Wallace Supply Co. 109
Ward & Sons, Edgar T. 102
Warner Instrument Co. 87
Warner & Swasey Co. 75
Waterbury Farrel Foundry & Mach. Co. 104
Watson-Stillman Co. 106
Webster & Perks Tool Co. ... 90
Wellman Sole Cutting Mach. Co. 103
Wells Bros. Co. 31
West Haven Mfg. Co. . 4th Cover
Westinghouse Elec. & Mfg. Co. 27
Westmacott Co., J. M. 101
Whatley, A. H. 95
Whitcomb-Blaisdell Machine Tool Co. 21
Whitman & Barnes Mfg. Co. . 20
Whitney Mfg. Co. 71
Whiton Mach. Co., D. E. 94
Wiley & Russell Mfg. Co. 105
Wiley & Sons, John. 34
Williams & Co., J. H. 28
Wilmarth & Morman Co. 95
Windsor Machine Co. 105
Wood's Sons, T. B. 109
Woodward & Powell Planer Co. 101
Worcester Mach. Screw Co. .. 30
Wormer Machinery Co., C. C. . 90
Wyke & Co., J. 101
Wyman & Gordon. ..... 4th Cover

Yale & Towne Mfg. Co. 107

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

Air Lifts

Ingersoll-Sergeant Drill Co., New York.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Ball Bearings

See Roller Bearings.

Band Saws, Metal

Greaves, Klusman & Co., Cin., O.
Niles-Bement-Pond Co., New York.

Barrels, Steel

Kilbourne & Jacobs Mfg. Co., Columbus, O.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Belt Dressing

Dixon Crucible Co., Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Blocks, Chain

See Hoists, Hand.

Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

Keuffel & Esser Co., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery

Acme Mchry. Co., Cleveland, O.
Brown Co., H. B., Easthampton, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Landis Mach. Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Books, Mechanical

Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Wiley & Sons, Jno., New York.

Boosters

C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provi., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.

Boring and Turning Mills *Continued*

Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Cabinets, Tool

Armstrong Bros. Tool Co., Chicago, Ill.

Calipers

Athol Machine Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.

Cams

Boston Gear Works, Boston, Mass.

Carborundum

See Grinding Wheels.

Castings, Die Molded

Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron

Birdsboro Steel Fdry. & Mach. Co. Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
U. S. Foundry & Sales Co., South Norwalk, Conn.

Castings, Steel

Baldwin Steel Co., New York.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.

Catalogue Makers

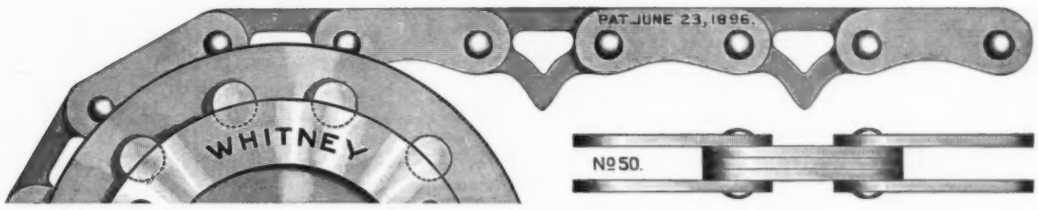
Binner-Wells Co., Chicago, Ill.

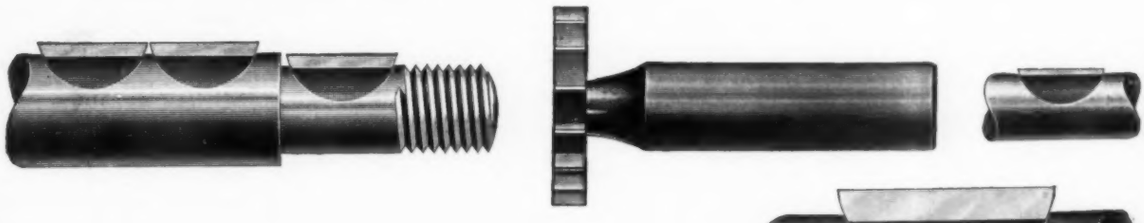
Cement, Cast Steel

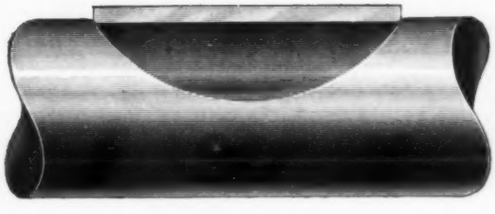
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines

Hendey Mach. Co., Torrington, Conn.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.







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Pratt & Whitney Co., Hartford, Conn.

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Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Faneuil Watch Tool Co., Boston, Mass.

Circuit Breakers
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Counterbores
Slocomb Co., J. T., Provi., R. I.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts, Friction
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Bolt
Brown Co., H. B., Easthampton, Conn.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Dickinson, Thos. L., New York.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.
Swaine Co., Fred J., St. Louis, Mo.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Keuffel & Esser Co., New York.

Drawing Materials
Keuffel & Esser Co., New York.

Drilling Machines, Bench
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Drilling Machines, Portable
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Dwight Slate Mach. Co., Hartford, Conn.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.,
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Mechanics Machine Co., Rockford, Ill.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

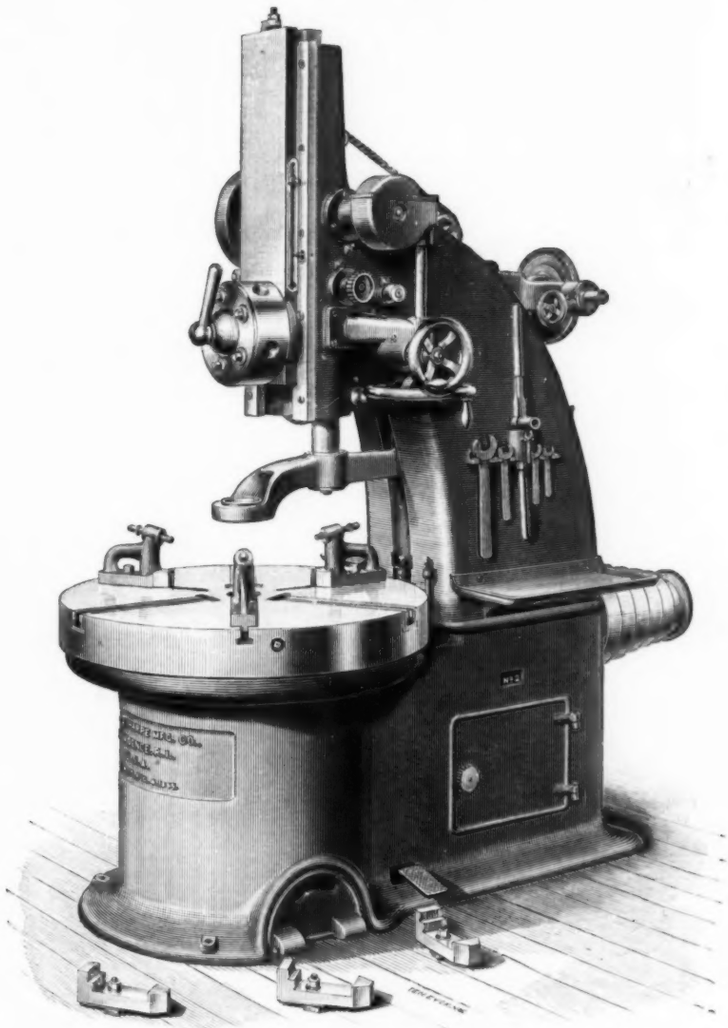
Drills, Center
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U.S.A.

Vertical Chucking Machines

TWO SIZES



For Boring Pulleys, Gears and Work of a Similar Character

May be fitted with jigs and fixtures and adapted to much of the work ordinarily done on a machine with a horizontal spindle. The work is easily placed in position. The chips drop through the spindle and do not wear the tools.

CAPACITY: No. 1—Bores a hole 11 in. deep in work to 26 in. diameter, with 12 in. face, or 28 in. diameter, with 11 in. face. Distance from end of upright to top of table, 14 1-8 in. No. 2—Bores a hole 14 1-2 in. deep in work to 36 in. diameter, with 14 1-2 in. face. Distance from end of upright to top of table, 17 in. Descriptive circulars giving details mailed to any address free of charge.

Drills, Pneumatic
Allen, Jno. F., New York.
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.

Drills, Ratchet
Billings & Spencer Co., Hartford, Conn.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dust Collectors
Allington & Curtis Mfg. Co., The, Saginaw, Mich.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrical Supplies
Clark, Jr., & Co., Jas., Louisville, Ky.
Cutler-Hammer Clutch Co., Milwaukee, Wis.,
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Northern Elec .Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Street Bros. Machine Co., Chattanooga, Tenn.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Clark, Jr., & Co., Jas., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting
McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.

Engines, Gas and Gasoline
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Rand Drill Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engravers
Binner-Wells Co., Chicago, Ill.

Engraving Machinery
Field, Chas. H., Providence, R. I.
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Fans, Electric
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Sturtevant Co., B. F., Hyde Park, Mass.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filing Machines
Henry & Wright Mfg. Co., Hartford, Conn.
Rotary File & Mach. Co., Brooklyn, N. Y.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Buffalo Forge Co., Buffalo, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Miner & Peck Mfg. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Lang Co., G. R., Cincinnati, O.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.

Forgings, Steel—*Continued*
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Forming Machines
Hartford Mch. Screw Co., Hartford, Conn.

Foundry Furnishings
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Friction Boards
Ingalls & Co., Castleton, N. Y.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.

Gears, Cut
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.

Gears, Cut—*Continued*
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Wks., Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Sturtevant Co., B. F., Boston, Mass.

Generators, Gas
American Gas Furnace Co., New York.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Cutter
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Diamond Mach. Co., Provi., R. I.
Heald Machine Co., Worcester, Mass.
Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

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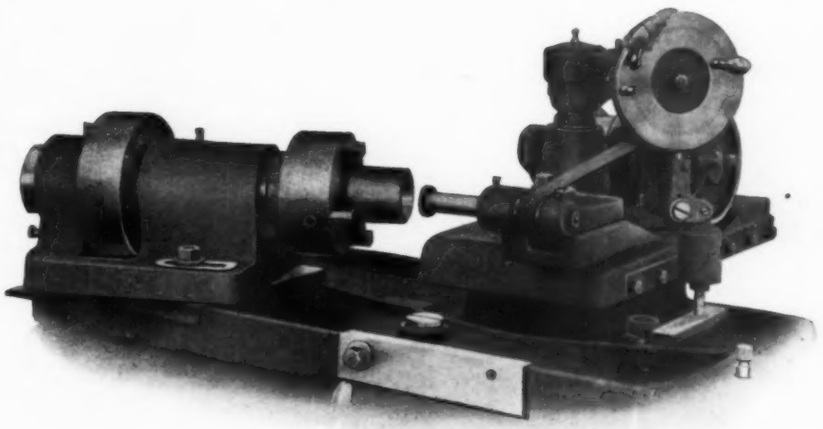
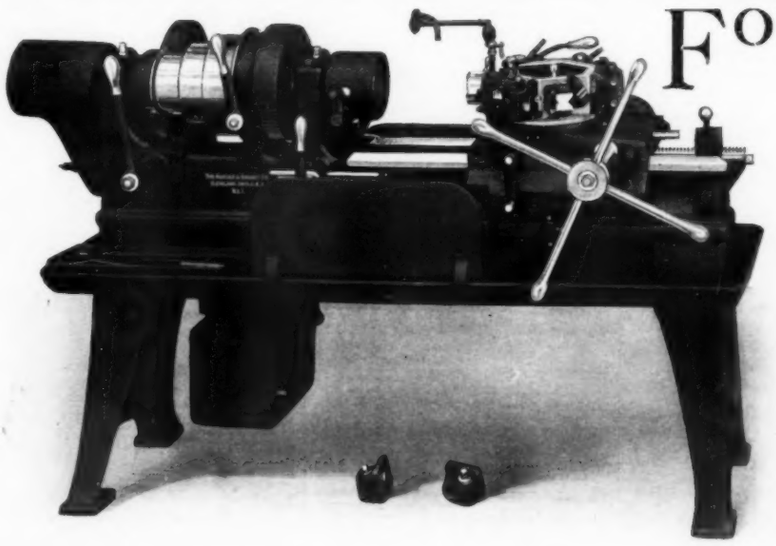


LANDIS TOOL COMPANY, Waynesboro, Pa., U. S. A.

AGENTS—Walter H. Foster Co., 513 Williamson Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty St., New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.



No. 1—1⅜ x 15 inches. Other Sizes:—No. 2, 2¼ x 24 and No. 3, 3⅝ x 36 inches.

FOR SMALL WORK

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Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
Heald Machine Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

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Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Field, Chas. H., Providence, R. I.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Abrasive Material Co., Philadelphia, Pa.
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Builders Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Machine Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hack Saw Blades and Frames
Goodell-Pratt Co., Greenfield, Mass.
Hammacher, Schlemmer & Co., New York.

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Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Starrett Co., L. S., Athol, Mass.
West Haven Mfg. Co., New Haven, Conn.

Hack Saws, Power
Fairbanks Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Millers Falls Co., New York.
Niles-Bement-Pond Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Electric
Northern Elec. Mfg. Co., Madison, Wis.

Hammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.
Rand Drill Co., New York.

Hammers, Power
Niles-Bement-Pond Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Vandyck Churchill Co., New York.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Pryibil, P., New York.
Wood's Sons, T. B., Chambersburg, Pa.

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Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

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Am. Gas Furnace Co., New York.

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Brown Hoisting Mchry. Co., New York.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Link Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.

Hoists, Hand—*Continued*
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Davis Mach. Co., W. P., Rochester, N. Y.
Hill-Standard Mfg. Co., Anderson, Ind.
Lapointe Machine Tool Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Street Bros. Machine Co., Chattanooga, Tenn.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knurls
Hammacher, Schlemmer & Co., New York.

Lamps, Arc
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Besly & Co., Chas. H., Chicago, Ill.

Lathe Dogs—*Continued*
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Davis Mach. Co., W. P., Rochester, N. Y.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Hill, Clarke & Co., Boston, Mass.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Silk Mach. Tool Co., P. P., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Stark Tool Co., Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Niles-Bement-Pond Co., New York.

Lathes, Brass
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Lathes, Wood
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., N. Y. City.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Lubricants
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Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

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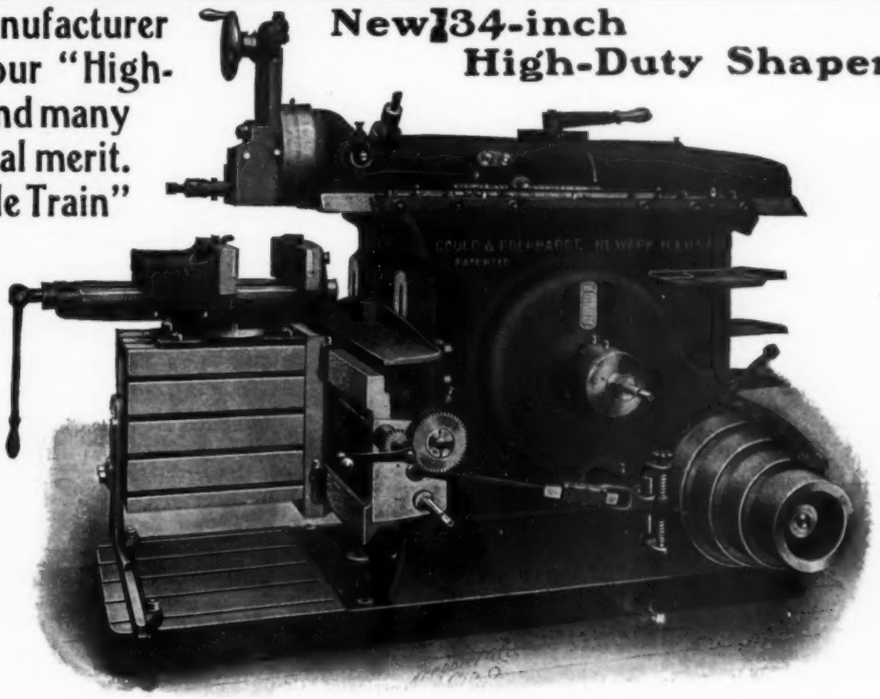
New 34-inch High-Duty Shaper



Gould & Eberhardt, Newark, N. J., U. S. A.

SELLING AGENTS—Prentiss Tool & Supply Co., New York, Boston and Buffalo. Baird Machinery Co., Pittsburg, Pa. Marshall & Huschart Machinery Co., Chicago. Motch & Merryweather Machy. Co., Cleveland. The Fairbanks Co., Philadelphia and Baltimore. Henshaw, Bulkley & Co., San Francisco. Hallidie Machy. Co., Seattle. W. R. Colcord Machinery Co., St. Louis. C. T. Patterson Co., New Orleans.

FOREIGN AGENTS—Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Selig, Sonnenthal & Co., London, England. Adolfo B. Horn, Havana, Cuba. F. W. Horne, Yokohama, Japan.

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End Mills of ALL SIZES and ALL TAPERS.
SPIRAL Cut, STRAIGHT Cut and CENTRE Cut carried in stock.
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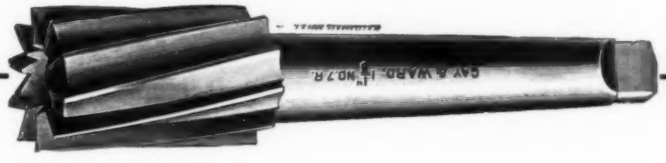

New York Store	Philadelphia Store	Boston Agent	London Agent
54 Warren Street	Field & Co., Manager	Edgar T. Ward & Sons	Chas. Neat & Co.
W. A. Darling, Manager	52 North Fifth Street	23-25 Purchase St.	112 Queen Victoria St.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

Machinery Dealers
Baird Machy. Co., Pittsburg, Pa.
Chandler & Farquhar, Boston, Mass.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McDowell, Stocker & Co., Chicago, Ill.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.
Wormer Mchy. Co., C. C., Detroit, Mich.

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Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Millers Falls Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Frasse Co., Peter A., New York.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Magnets, Lifting
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co. Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mechanical Draft
Sturtevant Co., B. F., Hyde Park, Mass.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd. New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.

Milling Machines, Hand
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mach. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Mach. Tool Wks., Philadelphia, Pa.
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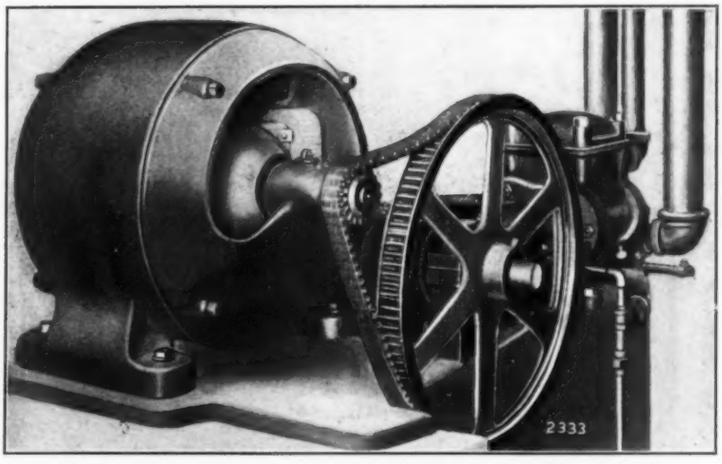

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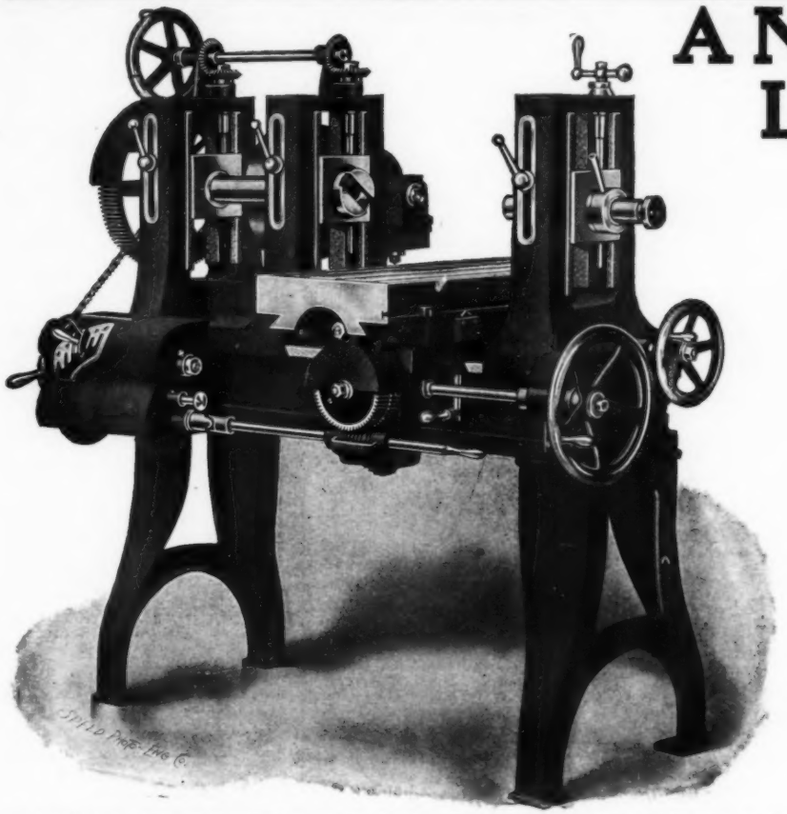

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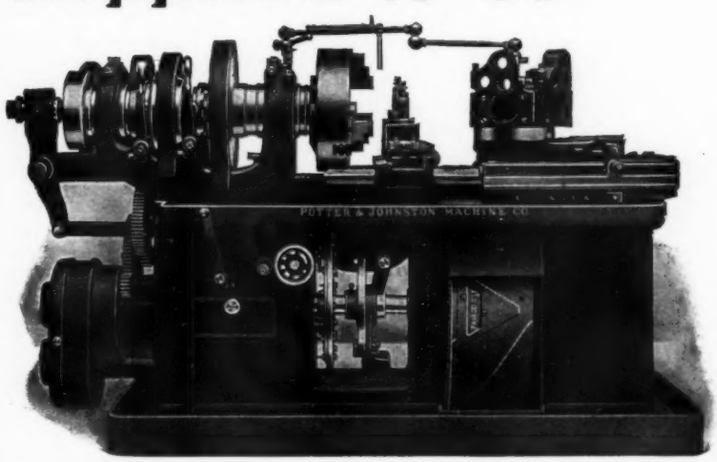

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Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Sprockets
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Wks., Boston, Mass.

Stampings, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.

Stampings, Welded
American Tube & Stamping Co., Bridgeport, Conn.
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Frasse & Co., Peter A., New York.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
American Tube & Stamping Co., Bridgeport, Conn.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston,

Steel, Tool
American Tube & Stamping Co., Bridgeport, Conn.
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Frasse & Co., Peter A., New York.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Morton & Co., B. K., Toronto, Canada.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.
Vickers, Sons & Maxim, Sheffield, England.
Ward & Son, Edgar T., Boston, Mass.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fitchburg Machine Works, Fitchburg, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Straighteners, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
General Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hart Mfg. Co., Cleveland, O.
Hartford Mach. Screw Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Frasse & Co., Peter A., New York.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reece & Co., E. F., Greenfield,
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.

Telephones
N. Y. Telephone Co., New York.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hart Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Geier Co., P. A., Cleveland, O.
Hill-Standard Mfg. Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.

Tool Holders—*Continued*
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pryibil, P., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.
American Tube & Stamping Co., Bridgeport, Conn.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Valves
See Steam Specialties.

Vises, Metal Workers'
Athol Machine Co., Athol, Mass.
Hammacher, Schlemmer & Co. New York.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Reed Co., H. E., Erie, Pa.
Reed Mfg. Co., Erie, Pa.
Williamson Mfg. Co., Bradford, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Williamson Mfg. Co., Bradford, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
American Tube & Stamping Co., Bridgeport, Conn.
C & C Elec. Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Welding Plates
Phillips & Sons Co., F. R., Philadelphia, Pa.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Pryibil, P., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Hawkeye Wrench Co., Marshalltown, Iowa.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.
Hawkeye Wrench Co., Marshalltown, Iowa.

The Use of Fuel Oil on the Pacific Coast—I.

EDITORIAL CORRESPONDENCE.

To one who has seen steam boilers fired in no other way than with coal—whether by hand with the accompanying shovels and wheelbarrows or by mechanical stokers with the accompanying elaborate coal and ash handling machinery—few things can be more attractive than the fire-room of a steam boiler fired with oil, and the further he compares the methods of handling oil with those necessary with solid fuel, the more attractive does the liquid fuel become. For purposes of power making, including locomotive power on railroads, as well as for industrial purposes generally, oil fuel is to-day practically universal on the Pacific coast, the term oil fuel being understood to include crude oil, distillate, gasolene and gas made by evaporating the last named.

The largest deposits of petroleum in California yield a thick, black product of heavy gravity containing about 13 per cent. of distillable products—a percentage so small that the oils cannot be commercially distilled and they are hence used just as they come from the wells. Their viscosity is so great as to sometimes make them almost semi-solid and somewhat troublesome to handle, and burners for oils of this character must be steam-jacketed to facilitate the flow of the oil through small pipes.

The accompanying half-tones will serve to illustrate the more important features of oil handling for fuel purposes on a large scale and in various applications.

STORING AND HANDLING.

Fig. 1 shows the receiving tank of the Southern Pacific Railway at Los Angeles, Cal.—a tank having a capacity for 55,000 barrels of oil, equivalent to about 15,000 tons of coal; the receiving, handling and distributing of which are all accomplished by one man. The pipe supported upon trestles goes to an open tank or vat below and between the rails of a siding at the top of the embankment, where the trains of oil cars are received. The discharge of the oil from the cars involves nothing more than opening a valve provided for that purpose on the car, with some waiting in case the oil is unusually viscous. On the embankment, at the right and outside the limits of the picture, is a small laboratory building where the oil is tested, the leading test being for the contained water, each increment of which above a prescribed minimum is allowed for in settling the bills, while an excess above a prescribed maximum leads to its rejection altogether.

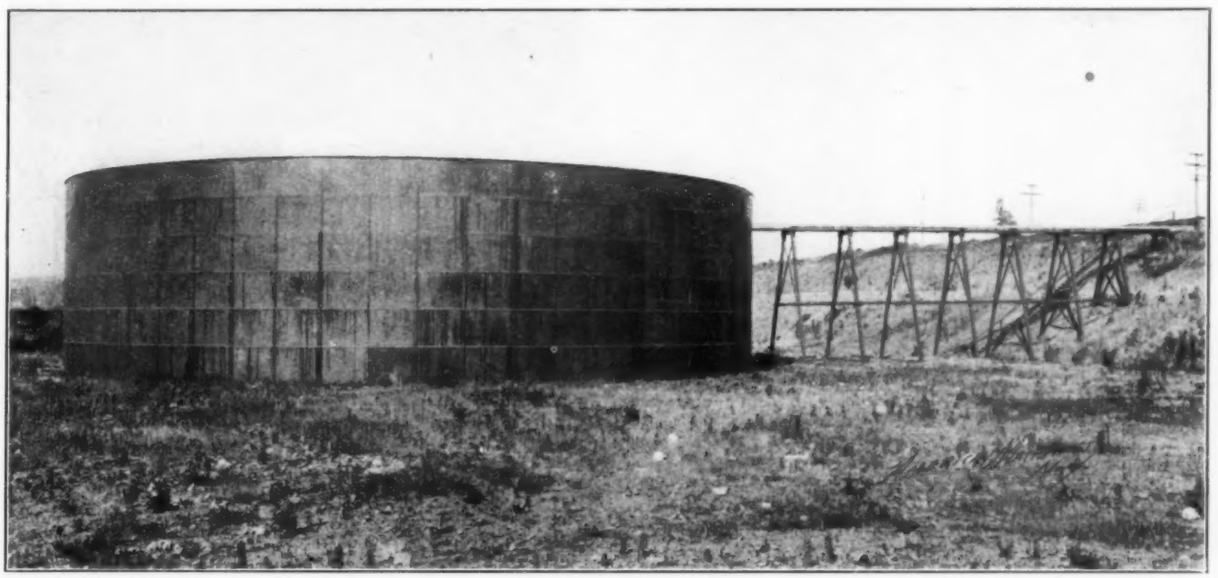


FIG. 1. RECEIVING TANK FOR FUEL OIL.

On the side of the tank beyond the observer in Fig. 1 is an automatic air-displacement pump by which the oil is sent to a service tank shown in Fig. 4, this latter being located at a distant point in the yard. The pumping apparatus is shown in Fig. 2 and more in detail in Fig. 3. This is probably the largest displacement pump that has ever been made. Its action is entirely automatic and in every way satisfactory. The tank is divided in half by a division head *a* and the pump is thus double acting, one end of the tank filling while the other is emptying. There is, however, but one main float, *b*, which controls both chambers. This float rises and falls with the oil, which enters the tank by gravity from the receiving tank shown in Fig. 1, through the pipes *c d*. At the limits of its motion the float engages collars *e f* and thus raises or lowers the plug frame *g*, on which pins are placed to tilt the weighted lever *h*, which, passing over the center, shifts a small valve in the valve box *i* and admits air to one or other end of the tank. At the same time air is carried to pistons connected with check valve *j* or *k* in the oil-supply pipe, insuring its instant closing, and to pistons connected with exhaust valve *l* or *m*, insuring its instant opening.

After this air is discharged and the tank is again full of oil, the exhaust valve is closed by the supplementary float *n* or by a similar float, not shown, fitted to the valve *m*.

"OILING" LOCOMOTIVES.

The elevated tank shown in Fig. 4 is a service tank so far as supplying the locomotives is concerned, and a storage tank for other purposes. The oil from the pumping station is delivered through a 6-inch pipe, of which the end is vertical and located within and near the top of the tank at the desired upper level. It is surmounted by a valve, shown in Fig. 5, which, in the position shown, is open, the oil discharging freely, as indicated by the arrows. When the tank is full, however, the float *a* rises and closes the valve, thus stopping the flow of oil, and when, by reason of a draft on the supply, the level of the oil drops the float drops with it, the valve opens and the flow of oil is resumed. It will be observed that there is nothing positive about the displacement pump and no damage can result from closing its discharge pipe, the result being simply to establish a pressure in the oil pipe system of about 40 pounds per square inch. The pump may, in fact, be looked upon as an apparatus for supplying an artificial head, the valve shown in Fig. 5 being nothing more than a magnified ball float cock of the type used with plumbing fixtures.

In the foreground of Fig. 4 will be seen the standpipes for delivering the oil to the locomotive tenders. These are quite

GERMAN METHODS OF DENATURIZING.

I. Complete denaturization by the German system is accomplished by the addition to every 100 liters (equal to 26½ gallons) of spirits:

(*a*) Two and one-half liters of the "standard denaturizer," made of 4 parts of wood alcohol, 1 part of pyridin (a nitrogenous base obtained by distilling bone oil or coal tar), with the addition of 50 grams to each liter of oil of lavender or rosemary.

(*b*) One and one-fourth liters of the above "standard" and 2 liters of benzol with every 100 liters of alcohol.

Of alcohol thus completely denaturized, there were used in Germany, during the campaign year 1903-4, 931,406 hectoliters denaturized by process (*a*), as described above, and 52,764 hectoliters which had been denaturized by process (*b*). This made a total of 26,080,505 gallons of wholly denaturized spirits used during the year for heating, lighting and various processes of manufacture.

II. Incomplete denaturization—*i. e.*, sufficient to prevent alcohol from being drunk, but not to disqualify it from use for various special purposes, for which the wholly denaturized spirits would be unavailable—is accomplished by several methods as fol-

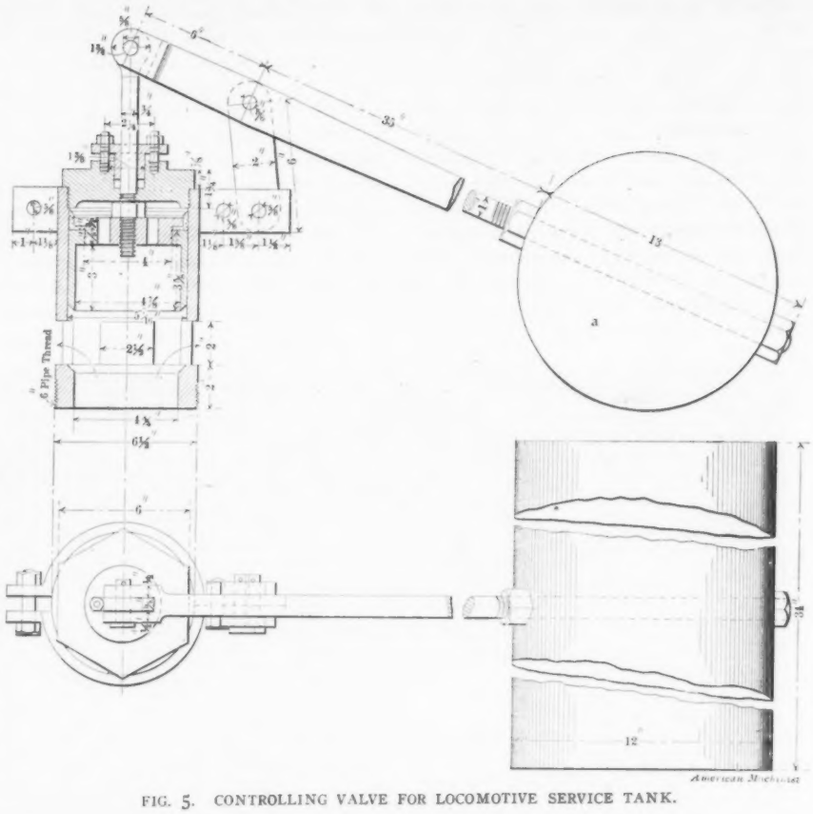


FIG. 5. CONTROLLING VALVE FOR LOCOMOTIVE SERVICE TANK.

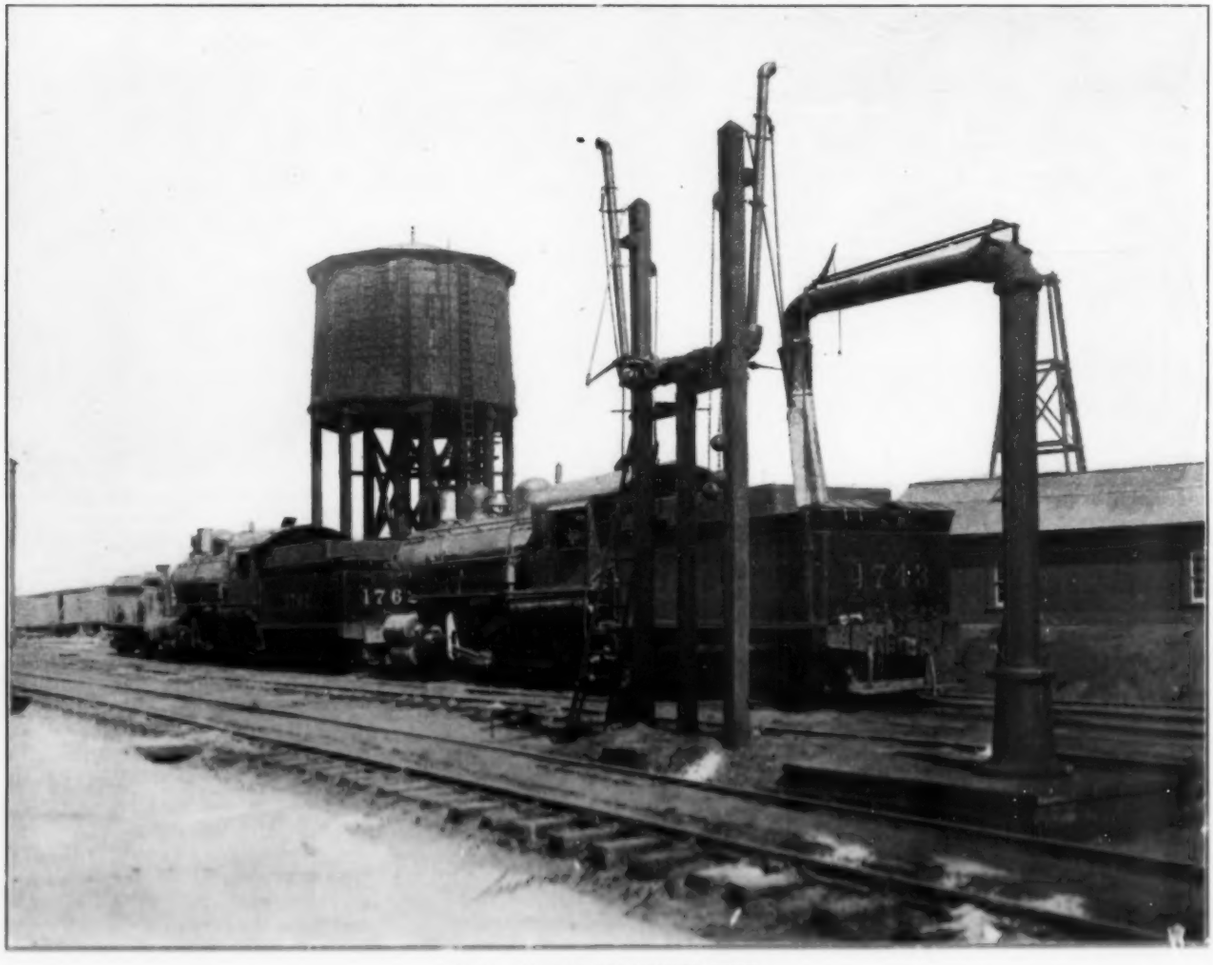


FIG. 4. LOCOMOTIVE SERVICE TANK.

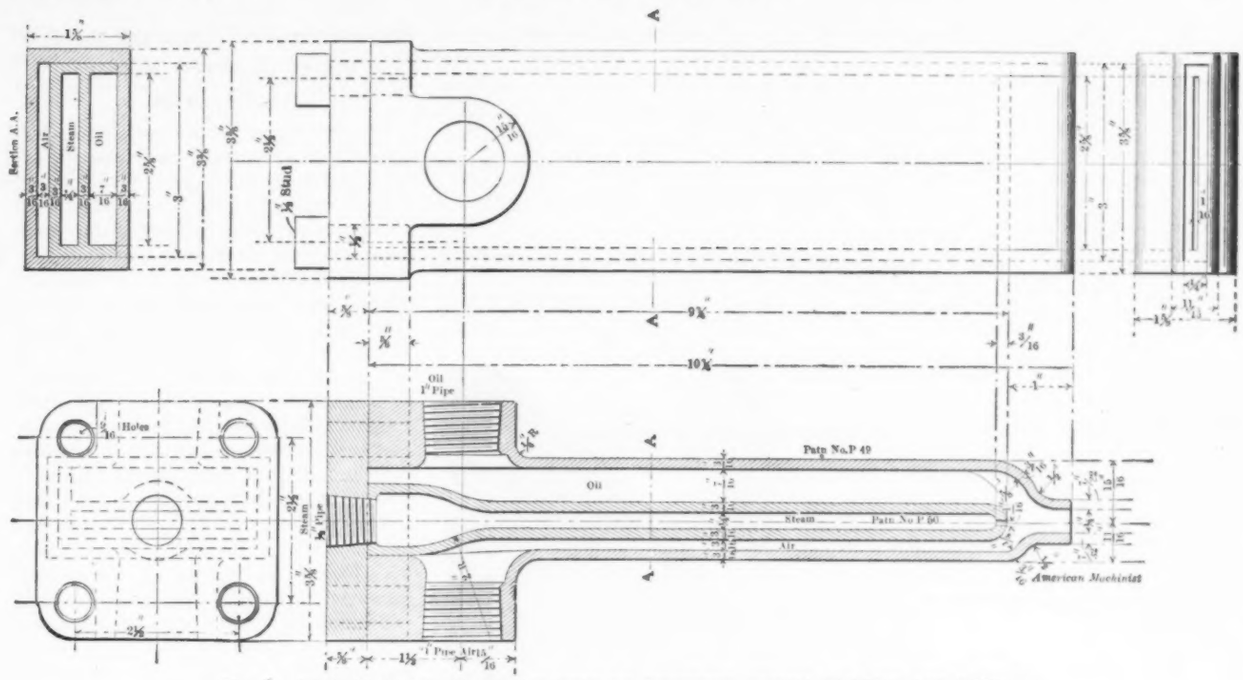


FIG. 6. HIGH-PRESSURE OIL BURNER USED ON SOUTHERN PACIFIC RAILWAY LOCOMOTIVES.

low, the quantity and nature of each substance given being the prescribed dose for each 100 liters (26½ gallons) of spirits:

(*c*) Five liters of wood alcohol or one-half liter of pyridin.

(*d*) Twenty liters of solution of shellac, containing 1 part gum to 2 parts alcohol of 90 per cent. purity. Alcohol for the manufacture of celluloid and pegamoid is denaturized.

(*e*) By the addition of 1 kilogram of

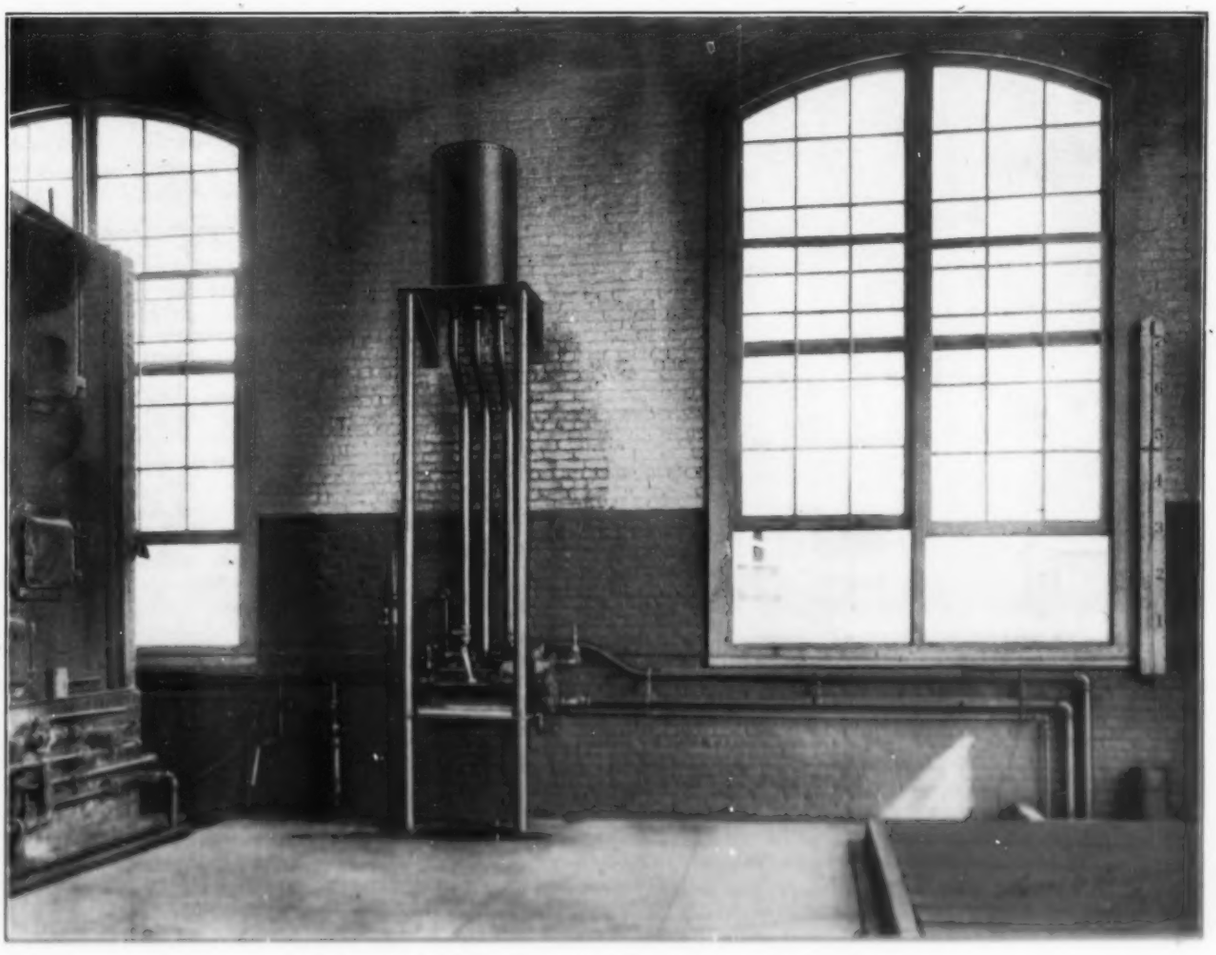


FIG. 7. SERVICE TANK AND PUMP FOR A STATIONARY BOILER PLANT.

similar to the standpipes for water, one of which also is included in the picture. Oil and water are thus supplied at the same time and in the same manner and, just as a fireman is said to "water" his engine when he fills the tender tank with water and to "coal" it when taking on coal, so he is said to "oil" it when taking on oil. The tender oil tanks will be seen in Fig. 4, although in this detail there is, as yet, considerable diversity.

BURNERS.

There is great diversity in the forms of burners used with oil, and one might at first be excused for thinking that most any collection of pipes would make an efficient oil burner.

The fundamental differences between various burners lie in the use of air or steam for atomizing the oil and in the use of high or low pressure. Air is undoubtedly better than steam, although, about a boiler plant, steam is obviously more convenient than air. Moreover, as already stated, some of the oils used are so viscous as to make it necessary to use a steam jacket on the oil pipe in order to make the oil thin enough to atomize readily. These considerations lead to the more general use of steam.

All high-pressure burners give out a loud roar, which, with many of them in use, as in a blacksmith shop, is very oppressive, and with many of them this is accentuated by a drumming sound, due to a series of incipient explosions. Low-pressure burners are silent, and just why they are not more used is not easy to learn. Some use them with entire success, while others declare them a failure. Low-pressure burners use air for atomizing without auxiliary steam heat, which indicates plainly enough that the oil used is comparatively fluid, and it is quite likely that the success or failure of this type of burner may turn on the viscosity of the oil used with it.

Fig. 6 shows the burner used on the locomotives of the Southern Pacific Railway, as well as for many other purposes.* It is of the high-pressure type, and requires a steam pressure of not less than 80 pounds for the best results. It is entirely free from drumming, although not from roaring. It may be compared with the burner shown at page 278, in connection with the brass furnace at the Herron Pump Works, which also is a high-pressure burner. In both, air is admitted through the burner, but with the differences that in the Herron design all of the air required for combustion is thus admitted and that it is supplied under light pressure from a blower, while in the Southern Pacific design but a small part of the total air required is thus admitted, and it is drawn in from the atmosphere by the aspirating action of the jet. While the amount of air thus supplied to the Southern Pacific burner is relatively small, it is essential if the combustion is to be smokeless. Used under stationary boilers, this burner is absolutely smokeless; but the closing of the air inlet to the burner for a single second, will cause a cloud of smoke to appear at the top of the stack. The burner will be seen to have a steam jacket incorporated in its structure.

The capacity of these burners is astonishing, and their flexibility almost equally so. The burner shown in Fig. 6 has an opening of ¼x3 inches, and through one such opening a sufficient supply of fuel is delivered to supply the largest locomotives, developing, perhaps, 1,000 horsepower. What its low limit of performance is I do not know, but the same burner is used under stationary boilers developing perhaps 100 horse-power each.

Of course, firing an oil-fired boiler is a "cinch," the fireman having scarcely

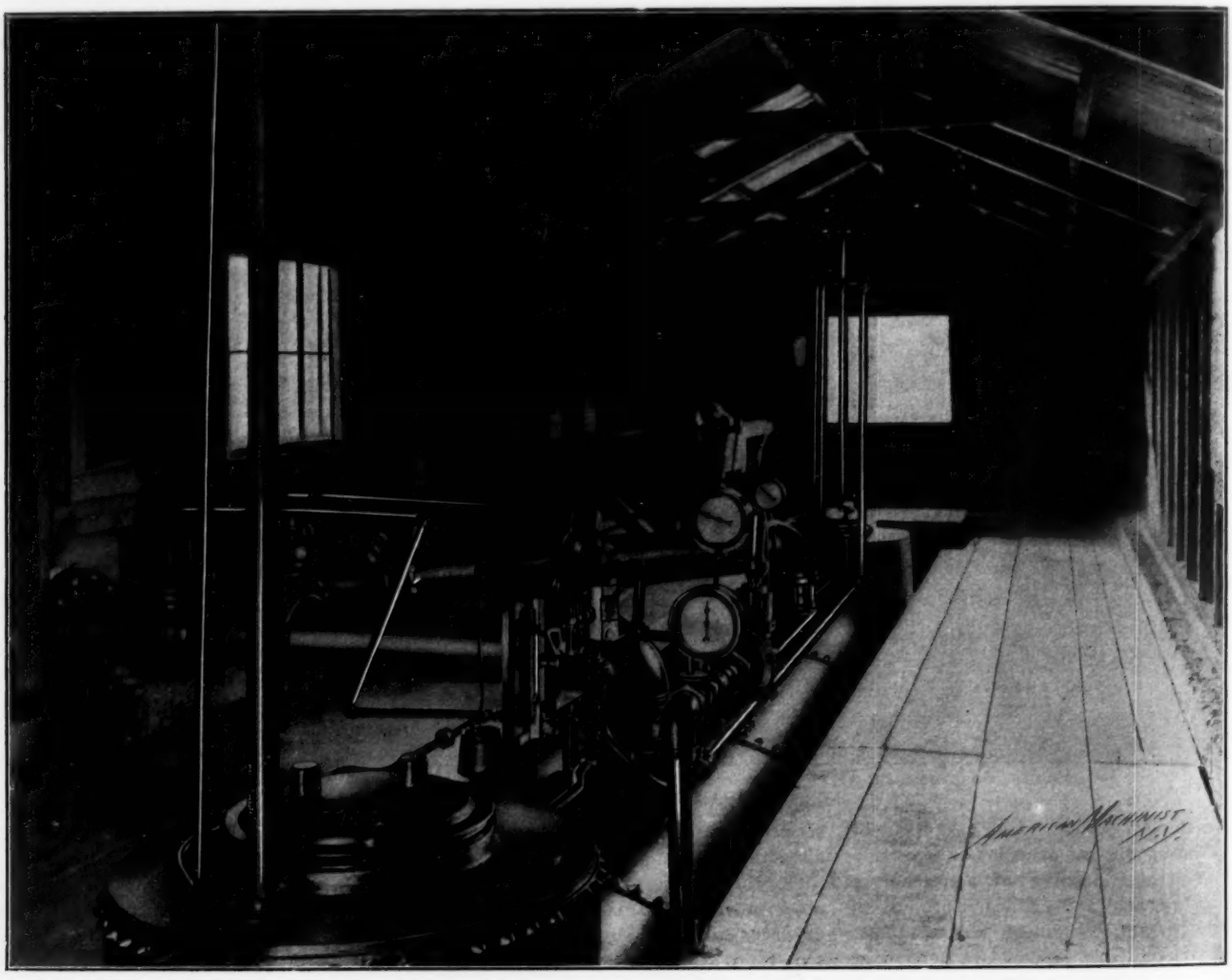


FIG. 2. PNEUMATIC DISPLACEMENT PUMP.

*The burner is patented.

enough to do to keep him out of mischief. It is here, in fact, that the oil is seen at its greatest advantage, and another is seen in the absence of deposit in the tubes. While, under road conditions, oil-fired locomotives are seldom smokeless, there is, in service, no appreciable deposit in the tubes. Such a deposit does, however, take place when the locomotive stands for any length of time with checked fires. To remove this, the engine carries a supply of sand, of which a few shovelfuls are thrown into the fire-box after the engine is in motion, and the scouring effect of the sand on the deposit is such as to lead for a few moments to a cloud of smoke, heavy enough, apparently, for one to walk on.

FIRING STATIONARY BOILERS WITH OIL.

Fig. 7 shows the method of supplying stationary steam boilers at the Los Angeles shops with oil. At the right and below the floor, is a tank, which is filled from time to time by hand-controlled valves connecting it with the yard tank of Fig. 4, a scale and pointer at the right of the window showing, by its connection with a float within the tank, the amount of oil on hand. By merely reading the indications of the pointer at the beginning and ending of a day's work, the consumption of oil is determined and reported. Between the windows, and elevated somewhat above the level of the burner, is a small service tank into which oil is pumped by the constantly running pump below it. The right-hand pipe delivers the oil from the pump to the tank; the left-hand one delivers it from the tank to the burner, and the middle one is an overflow leading back to the tank below the floor. The speed of the pump is maintained at a point which will insure a slight excess of the supply, this excess finding its way back to the main tank by way of the overflow. In some other places the head required for the burner is obtained by making it a closed tank and admitting compressed air to it. The aim in both cases is the same—to have but a small amount of oil under a head and connected with the burner. At the Sacramento shops of the Southern Pacific Railway this precaution is considered unnecessary, and large tanks are placed at an elevation, as shown in Fig. 8, which shows a tank of the blacksmith shop. The top of the tank is connected by a pipe and valve with a steam boiler, so that in case of a fire steam may be turned on. The large size of these tanks makes automatic control of the oil within them unnecessary, and an oil tender is employed for that purpose.

F. A. H.

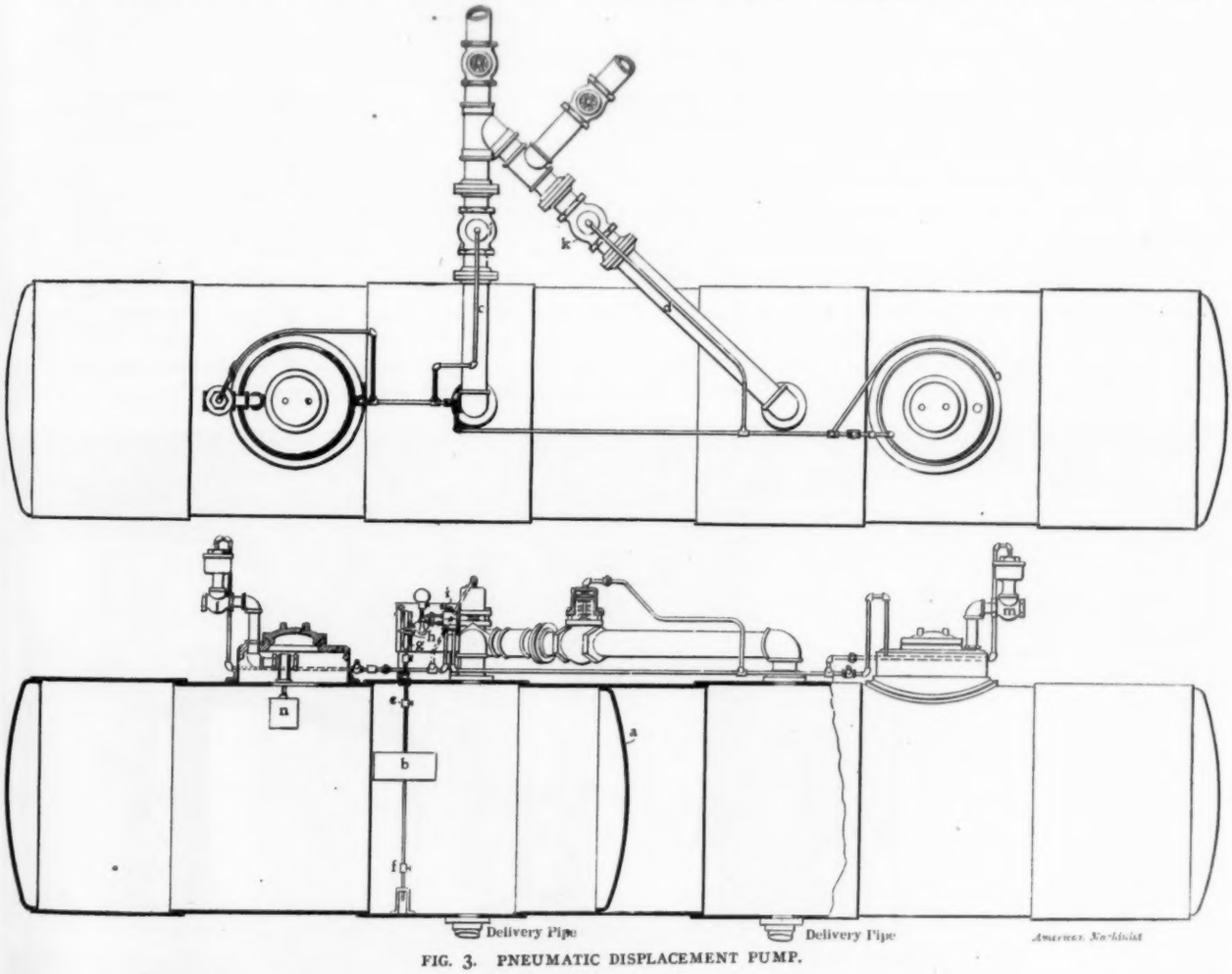


FIG. 3. PNEUMATIC DISPLACEMENT PUMP.

Industrial Use of Alcohol in Germany.

In connection with the articles on the above subject and on denaturing alcohol, at pages 198 and 199, the following extract from an additional report by Consul-General Mason, at Berlin, will be of interest as giving more elaborate information about methods of denaturizing:

For the reasons explained in my previous report, the consumption of alcohol in Germany as fuel for portable and stationary engines, automobiles, etc., has decreased rather than increased the past two years, and amounted during the last campaign year to not more than 951,000 gallons, or less than 1 per cent. of the whole alcohol product of the same year.

For most industrial purposes alcohol is used in Germany duty free, after having been "denaturized," or rendered unfit for drinking purposes, by admixture, in presence of a Government official, with a prescribed percentage or proportion of one or more of several different substances prescribed in the very elaborate statute which governs that complicated subject in this country. There are two general classes or degrees of denaturizing, viz., the "complete" and the "incomplete," according to the purpose for which the alcohol so denaturized is to be ultimately used.

GERMAN METHODS OF DENATURIZING.

I. Complete denaturization by the German system is accomplished by the addition to every 100 liters (equal to 26½ gallons) of spirits:

(*a*) Two and one-half liters of the "standard denaturizer," made of 4 parts of wood alcohol, 1 part of pyridin (a nitrogenous base obtained by distilling bone oil or coal tar), with the addition of 50 grams to each liter of oil of lavender or rosemary.

(*b*) One and one-fourth liters of the above "standard" and 2 liters of benzol with every 100 liters of alcohol.

Of alcohol thus completely denaturized, there were used in Germany, during the campaign year 1903-4, 931,406 hectoliters denaturized by process (*a*), as described above, and 52,764 hectoliters which had been denaturized by process (*b*). This made a total of 26,080,505 gallons of wholly denaturized spirits used during the year for heating, lighting and various processes of manufacture.

II. Incomplete denaturization—*i. e.*, sufficient to prevent alcohol from being drunk, but not to disqualify it from use for various special purposes, for which the wholly denaturized spirits would be unavailable—is accomplished by several methods as fol-

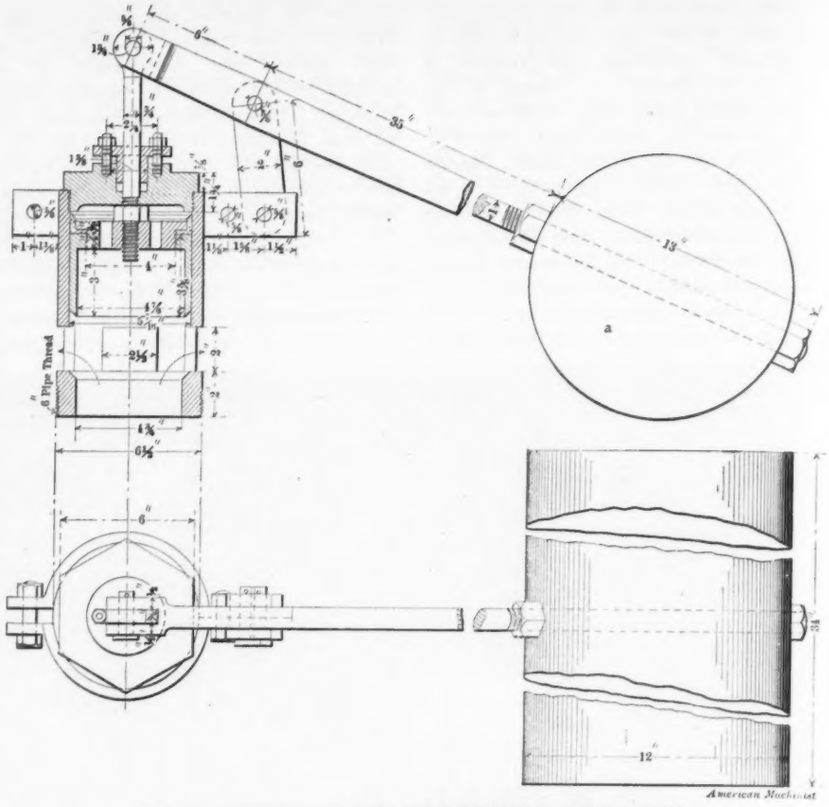


FIG. 5. CONTROLLING VALVE FOR LOCOMOTIVE SERVICE TANK.

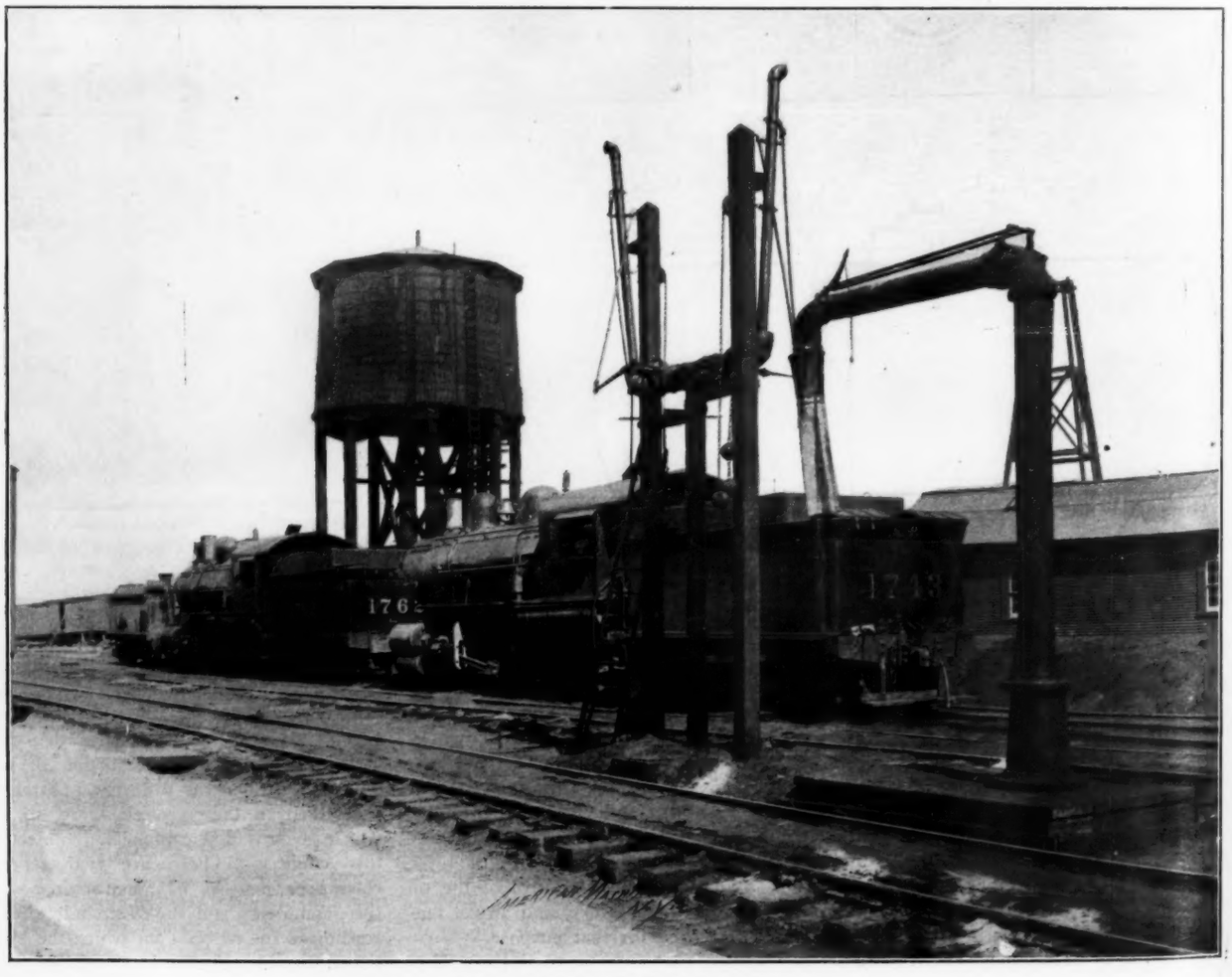


FIG. 4. LOCOMOTIVE SERVICE TANK.

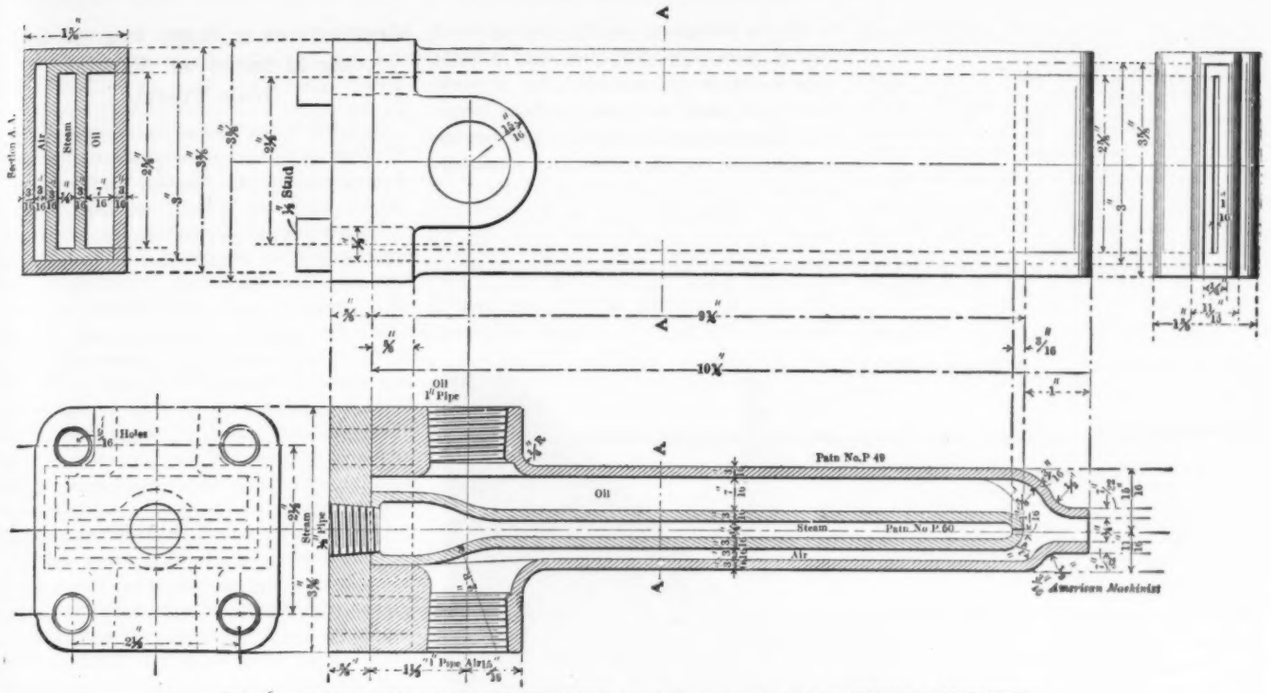


FIG. 6. HIGH-PRESSURE OIL BURNER USED ON SOUTHERN PACIFIC RAILWAY LOCOMOTIVES.

low, the quantity and nature of each substance given being the prescribed dose for each 100 liters (26½ gallons) of spirits:

(*c*) Five liters of wood alcohol or one-half liter of pyridin.

(*d*) Twenty liters of solution of shellac, containing 1 part gum to 2 parts alcohol of 90 per cent. purity. Alcohol for the manufacture of celluloid and pegamoid is denaturized.

(*e*) By the addition of 1 kilogram of

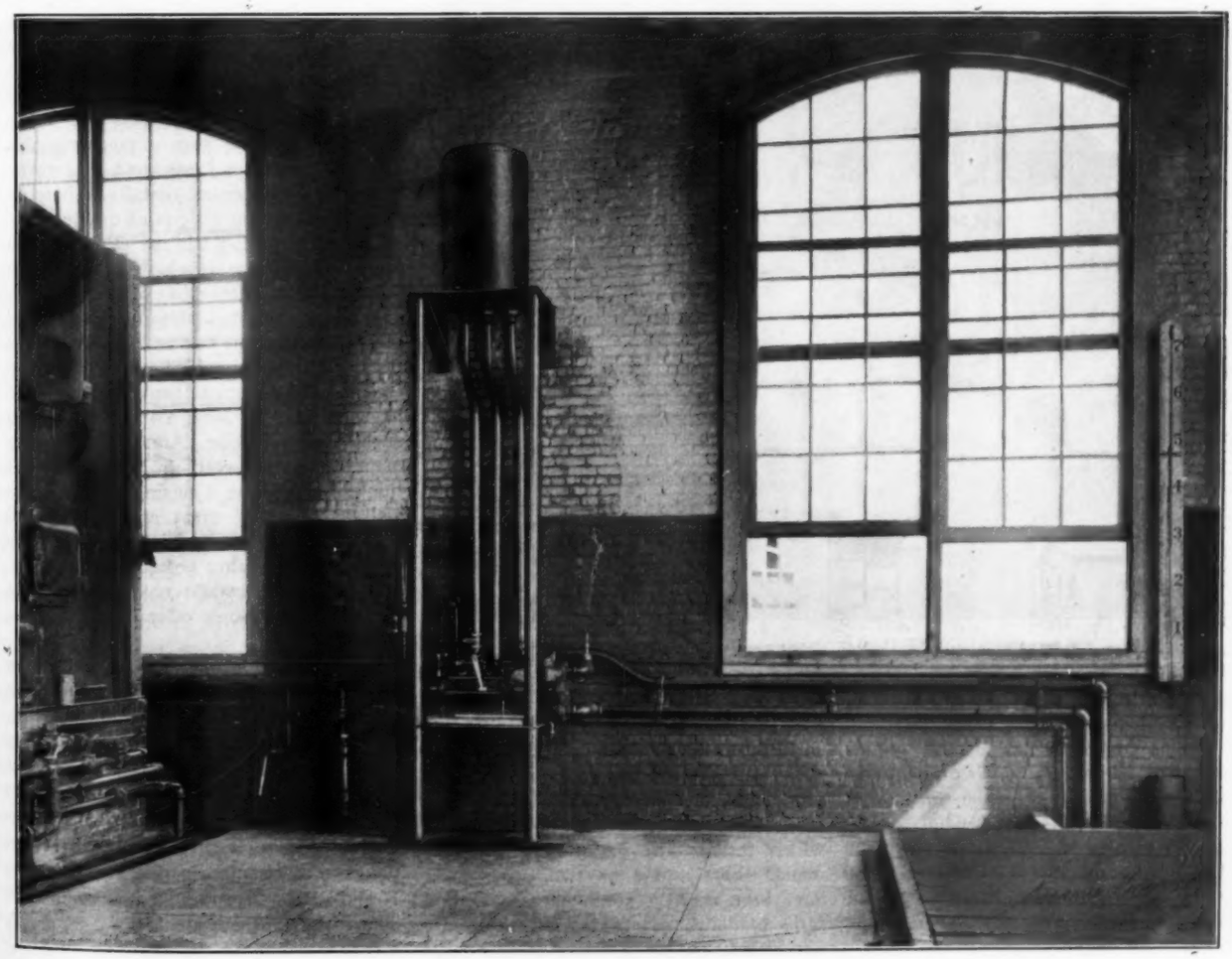


FIG. 7. SERVICE TANK AND PUMP FOR A STATIONARY BOILER PLANT.

camphor or 2 liters oil of turpentine or one-half liter benzol to each 100 liters of spirits. Alcohol to be used in the manufacture of ethers, aldehyde, agarcin, white lead, bromo-silver gelatins, photographic papers and plates, electrode plates, collodion, salicylic acid and salts, aniline chemistry, and a great number of other purposes, is denaturized by the addition of—

(*f*) Ten liters sulphuric ether, or 1 liter of benzol, or one-half liter oil of turpentine, or 0.025 liter of animal oil.

For the manufacture of varnishes and

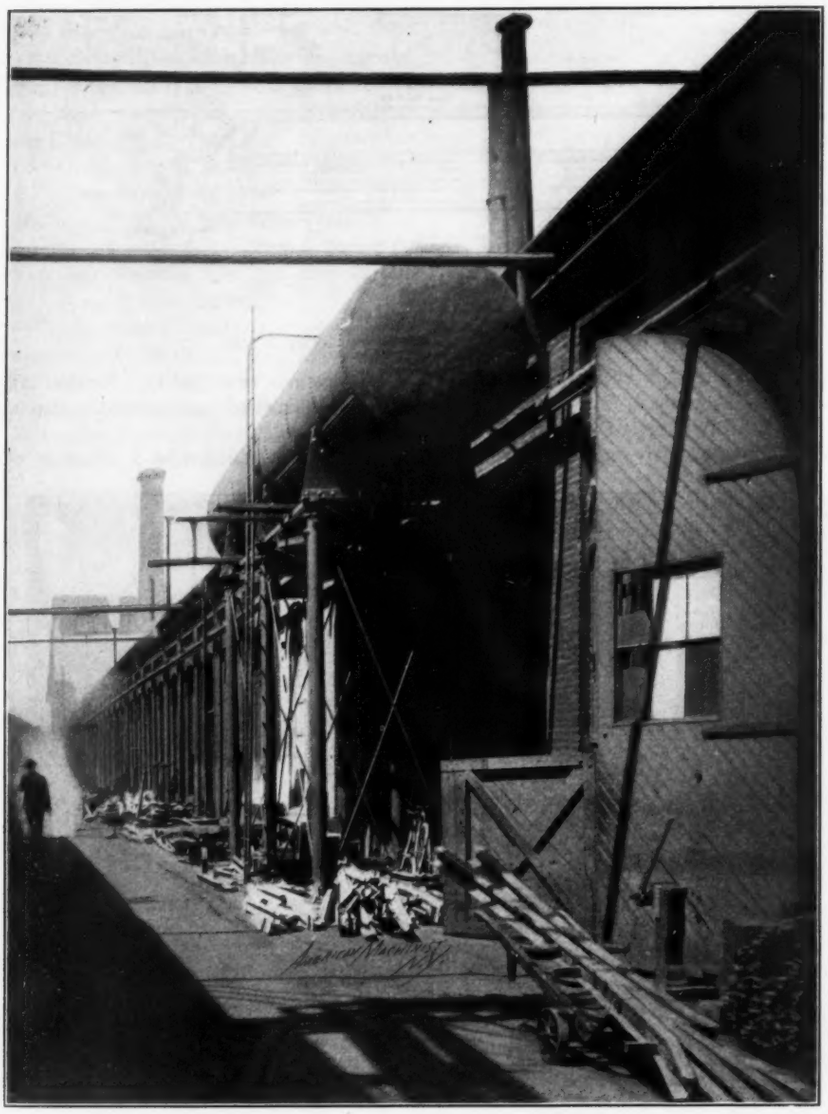


FIG. 8. SERVICE TANK AT THE SACRAMENTO SHOPS.

ink alcohol is denaturized by the addition of oil of turpentine or animal oil, and for the production of soda soaps by the addition of 1 kilogram of castor oil. Alcohol for the production of lanolin is prepared by adding 5 liters of benzin to each hectoliter of spirits.

The whole amount of incompletely denaturized alcohol of the several grades above described which was consumed in Germany last year was 385,946 hectoliters, equal to 10,227,569 gallons. In addition to all the foregoing, 21,779 hectoliters of alcohol were used duty free and without denaturization of any kind for governmental or public purposes, such as hospitals, Government laboratories and for the manufacture of fulminates and smokeless powder.

The striking point in the manufacture of Japanese paper is the absence of machinery. Everything is done by manual labor. Factories are almost unknown, the industry being carried on in a small way by each family separately. Except where the members of a family are insufficient there is no hired labor, and consequently paper-making families are less affected by the rise and fall in prices which follows the variation in the demand. Lately, one or two paper mills have been erected, notably in Osaka and Oji, a suburb of Tokio, but these are almost entirely engaged in making foreign paper.—*The Engineer.*

Manufactures in Japan and the Selling of Improved Machine Tools There.

In a letter recently at hand from Chas. A. Francis, of the mechanical engineering department of the Higher Technological School at Tokio, Japan, he says:

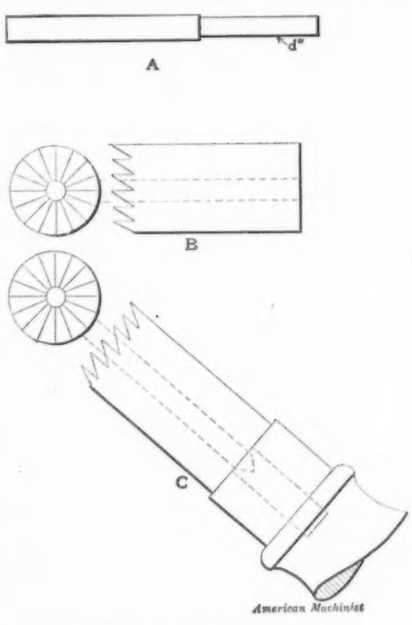
"Regarding your request for my own impressions of things in Japan, I think that the American public is getting pretty well supplied with such matter, judging from the American papers which reach us here, and some of these impressions do not seem to impress the foreign residents in this country very favorably. Some of them wonder which of the many books that were published ten or more years ago the writer has been reading. Some of the statements we run across in these articles were true some ten years ago, but do not hold good at the present date at all. It is a saying here that every foreigner who comes for a month's stay generally returns and writes a book on Japan, and I have thought that perhaps this is the best way, for I find that the longer one stays the harder it is to understand and trace the true reason for many things, and the less desire one has to put his thoughts on paper. He thinks himself incapable of writing anything that would be of interest to the general public until he has had more time for study, and the more study given to a subject the more it grows; this is the way it seems to me. I do not mean this to apply to everything that we see in the newspapers and magazines, for I have seen some very able articles written on Japan, and it is owing to these few articles that I hesitate to put down any impressions of my own.

"There is no doubt in my mind but that there will be great developments along industrial lines after the present war is over; in fact, it has already started to a certain extent, but one of the first things the Americans should have here in the Orient is an American bank, and it should have its head in New York, for through such an institution American business men could transact their business, and I think it would be a paying enterprise as well as being of great assistance to all manufacturers having interests in this country. Not being posted on the financial question, I would not wish to state this as a fact; I only offer it as a suggestion.

"In order that the various American manufacturing companies may secure the full amount of business along their chosen line, they must adopt some method by which the selling price of their product would be regulated in this country, otherwise the American products will not command the market they should, owing to the great fluctuation in prices at this end. I find that there are many complaints among the Japanese along this line, and it was only a month or so ago that my attention was called to a list of tools which

had been made out by one of the Government officers, which called for English tools exclusively, and the reason given for it was that he could not obtain prices on American machines twice alike, but that he could go to any reliable English representative and get prices on English tools and the prices were always the same. He stated that he knew that American machines were better, and if a correct price could be obtained would in most cases be below those of English make. He said that he could not understand why it was that American machinery prices fluctuated so much, and that he would go to any reliable English firm and they would show him just what a certain machine would cost at the home office, stating at the same time that they would have to charge him a certain fixed amount for their trouble in bringing the machine and delivering it, and that the prices were always the same, within a very small limit; but in cases of American machines the prices would vary as much as 50 per cent., which he thought was very queer. I have myself got prices on a certain size and make of machine for the school with which I am connected, and in some cases prices were obtained direct from the sole agent, and there has been as much as $100 difference without any reason for it, and in many cases I got prices from merchants, not direct agents, for the same tools, which prices were, lower than those of the regular agent. Therefore, as I look at it, it seems to me a good idea to have the home office regulate the prices at which these machines are to be sold if they want to see them widely used and have the trial they should to prove whether they are superior to the tools made in some other country. In other words, treat everyone alike. And they should not be afraid of advertising, and distributing their catalogues, so as not to have it said, as it has been, that one cannot get catalogues of American machines unless he is going to place an order.

"In order that American machine tools may be at the head here in the Orient the one selling them must adopt much different methods from which we would adopt in a similar business at home. He will come in contact with Japanese customs, and he must study every way to meet these customs. His success will be very small at first, or, if large, it will be of short life, unless he is thoroughly acquainted with the article which he has for sale, and thoroughly believes them to be the very best made. In my belief he must be willing to go into a manufacturing plant and instruct the workmen if need be in the various uses of the machines. In other words, I think that one in this line should be a practical mechanic in every respect; he should at the same time possess a certain amount of business ability in order to direct his office work. I have often been told that it is seldom that a first-class salesman and a merchant could be found in the same person. I think I would in this case choose the salesman to be more of a mechanic and allow someone else to look after the routine of office work, for it has been my experience here that often one can explain the essential points to a man and he listens with due respect, and when you are through tells you that it is very interesting, but in the next breath, before you have had time to come down from the heights to which his pleasant attention has put you, you are asked whether you have a machine on which you could teach his workmen how this could be done. Though your story may be very interesting and eloquently delivered, it does not amount to much unless you can show by



JAPANESE HAND-TURNING TOOLS.

simple and practical work how it can all be accomplished. The majority of those investing in manufacturing plants rarely understand any part of the work; therefore everything is left to the workmen, and if you are willing to teach them how to use your machines and tools, and you have an interest in them for them alone, then you can feel assured of obtaining a good listener in the financial head of the establishment.

"At the present time, the different departments of the Government are practically the only ones placing large orders; that is, outside of a very few large companies which have been established for a long time. These, of course, have men at their heads that are very capable; having studied in the different foreign countries, they are well abreast of the times; but it is the small industrial shops that are springing up all over the country that I believe the American manufacturer must cater to, as well as to the larger ones.

"To show what one has to contend with who is trying to sell American tools here among the small establishments, I wish to set before you two examples—they are not Chinese puzzles, but Japanese puzzles. The first is that of a number of shops making a line of water cocks and steam valves. They make these goods for a less amount than the same weight of material can be bought for, and in the manufacture of them no machine tools are used, with the exception of foot-power lathes of poor construction, and perhaps a blacksmith's hand-power drill; but none of the small attachments to these tools that the American workman thinks he cannot do without. The other instance which came to my notice was that of a shop in this city which employs fifteen to twenty workmen. They make sewing machines similar to the Singer, and they claim it is a very much better machine than the original Singer, owing to the fact that the Singer machines are only machine made, whereas these are hand made, therefore of superior quality. In this establishment they use no pneumatic automatic machine other than a hammer and cold chisel for roughing cuts on castings and a file for finishing cuts; all holes being drilled either with a small hand-driven breast drill, or a blacksmith's hand-power drill for the larger holes, and turning and grinding fits are made, where it is necessary, with the tools shown in the free-hand sketch inclosed; the tools are used in turning pieces shown at *A*. This I can state as a fact, for the proprietor sent to ask my advice about some way to improve the cutting quality of the two tools shown at *B* and *C*, and he demonstrated their use. These tools, I understand, have recently been patented for this class of work. The piece of material shown at *A* is approximately 3-16 inch cold-drawn stock, and has been cut off with a hack-saw and its ends filed to correct (?) length; it is next turned with the roughing tool shown at *B*, which is held between the fingers and rotated by the operator who furnishes the required feed. Of course no cut-meter is used to tell the cutting speed. After the roughing cut is taken, the finishing tool shown at *C* is used; this tool, as will be seen, is of much more elaborate construction than the roughing tool, as it has a wooden handle by which it is more rigidly held, giving a smoother and more accurate surface. The piece *A* has about 1-16 inch reduction in diameter, made by the use of these tools, as indicated at *d*. I am informed that the manufacturers can, and do, sell them for about 9 yen each, whereas the Singer, of *poor construction*, owing to the fact that it is made by machine, costs from 40 to 50 yen. Now, the puzzle is how would a salesman go about it to demonstrate that his company makes certain machine tools that will do this work cheaper than they are now doing it, and that no more capital will be needed in the installing of the plant?

"When I sat down to answer your letter I did not expect to write more than a few words, but as I seem to be a crank on American machine tools, it makes me a

little warm around the collar, especially in this warm weather, to see the way in which some American manufacturers fail to put the right foot forward in the matter of pushing their tools in this market."

Owing to the draining of Kern and King rivers by irrigation canals, the Tulare lake, in California, once navigable by steamers, is now perfectly dry. A man on foot can cross it safely at any point, and in some places the ground is hard enough for a team to drive over.—*The Engineer.*

Oil fuel is used at the central power station of the New Orleans drainage works, which supply current to a number of electric pumping plants. Sudden heavy rains make it necessary to start up rapidly, and oil has proved more efficient than coal for the purpose.—*The Engineer.*

A Method of Making a Templet for Worm-Gear Tooth Patterns.

BY JOHN J. SMITH.

About two years ago I needed a worm and segment of worm gear, about one-third of a complete gear, which was desired to be of large pitch for strength, and to work with as little friction as possible, the speed not being high, and the load not likely to be heavy when under motion, though possibly quite heavy when at rest.

The figures ultimately adopted for the gear are given in Fig. 1, the tooth-pitch being 3 inches, the thread-pitch or lead 6 inches, and the pitch diameter 6 inches. A price on a worm and segment of gear of these approximate proportions was obtained from the makers of Hindley gearing, but was so high in comparison with the service demanded, that it was believed that a saving could be made by making a cast worm and gear. It may be said here that this expectation was fulfilled, and that although there were only one worm and one gear-segment, the cost was considerably less than that for the Hindley gearing, with the advantage that duplicates can be obtained at trifling cost.

It was decided to make the gear teeth of such a shape as to give a line contact precisely as though the gear had been hobbed.

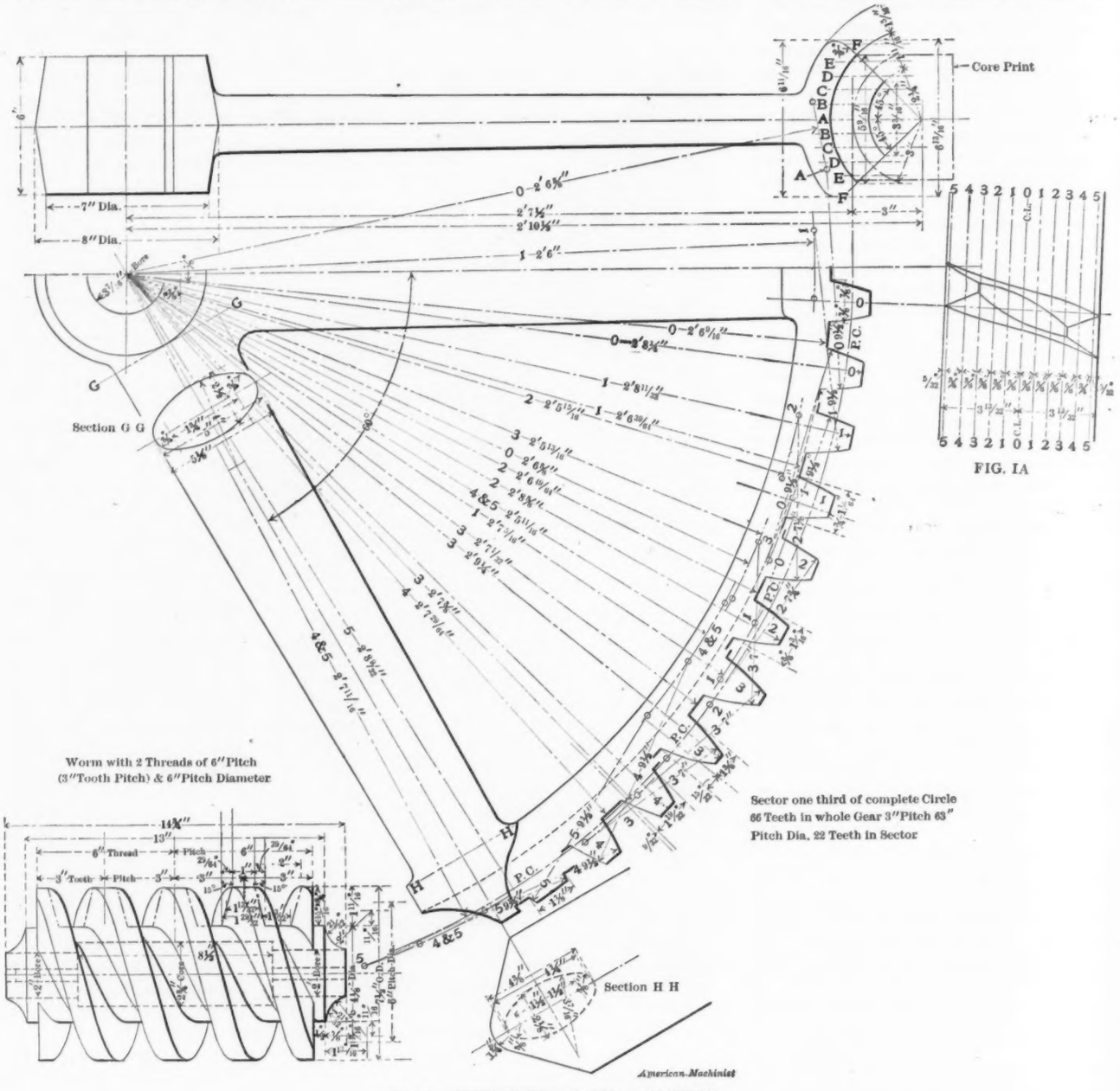

Core Print
7" Dia.
8" Dia.
Section G G
Section H H
Worm with 2 Threads of 6" Pitch
(3" Tooth Pitch) & 6" Pitch Diameter
Sector one third of complete Circle
66 Teeth in whole Gear 3" Pitch 63"
Pitch Dia. 22 Teeth in Sector
American Machinist

FIG. 1A

FIG. I. WORM-WHEEL SECTOR AND WORM.

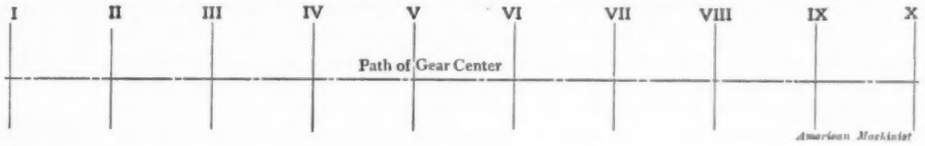
FINDING THE WORM SECTIONS.

The method of laying out tooth sections to accomplish this result is briefly stated in Unwin's "Elements of Machine Design," and by him attributed to Robert Briggs, of Philadelphia, now deceased.

Starting with the theorem that if a tooth section for one of a pair of mating gears be chosen, a tooth section for the other may be developed from it which will work properly with it, the rest is easy. The theorem is practically at the foundation of all gear designs, and does not need to be elaborated here.

A section of the central plane of the worm and gear is chosen at will. In this case the worm-thread side-angle was taken as 15 degrees, the dimensions of the thread being as shown in Fig. 1. This being established, the involute tooth to match it is easily obtained by various methods, but in the present case it was obtained in the same way as all the other gear tooth sections.

If we imagine a series of sections parallel to the central plane to be made through the worm and gear, we shall get sections from the worm based on the original tooth section, but varying in increasing degree from it as we get further away from the center. To obtain these sections is a matter of ordinary descriptive geometry, but a brief explanation may not be amiss. In Fig. 2 are shown a series of circles in full lines *A, B, C, D,* in which *A* is the outside diameter of the worm thread and *D* is the base diameter. *B* and *C* are so spaced as to divide the total distance from *A* to *D* into equal intervals. On the longitudinal section, Fig. 3, the right-hand half of the worm-thread section is shown at five spaces, which are the correct tooth spaces of the worm. These are shown in broken and dotted lines The first one at the left, the right-hand line of the tooth space is also added in the same kind of lines. Parallel to this is drawn a line A_0—D_0, which gives the tooth space as it would be if there were no clearance, this space being $A_0 D_0$ $D_0 A_0$. It is obvious that we need the tooth space with the clearance *deducted,* so as to generate the tooth to its correct size and not have any corrections for clearance to make after the sections are developed. A series of helices are now drawn corresponding to the circles *A, B, C, D.* These helices are lettered *aa, bb, cc, dd.* These, to prevent confusion, are drawn in successive adjacent tooth spaces, and are so located axially as to be in the helical side-surface of the tooth. In other words, the points *a, b, c, d* are the tops or vertices of the successive helices corresponding to the circles mentioned and lying *in* the surface of the worm teeth. Parallel sections, chosen equidistant for convenience, are now drawn, beginning with 0—0, the center line, and numbered 1—1, 2—2, 3—3, 4—4. Their intersections with the circles *A, B, C, D* are lettered A_0, B_0, A_1, B_1, and so on. Denoting the first tooth section from the center by the subscript 1 in each case, the second with the subscript 2, and so on, we have these sections in the different tooth spaces of the worm passing from left to right successively. Their method of development is simple. It will be noticed that center lines are shown which are the centers of the central section of the worm tooth, numbered successively with Roman numerals from I to X; that at the left of the section $A_0 D_0 D_0 A_0$ being III; that for the section 1, IV, and so on. The intersection A_1, Fig. 2, is projected over the helix *aa,* and the point A_1, Fig. 3, is obviously the top point of this tooth section. The point B_1 is projected over the helix *bb,* and the horizontal distance from the center line V to this point is carried with dividers and set off on the same horizontal line, continued, from the center line IV. This gives the second point of the No. 1 section denoted by the point B_1 of Fig. 3. The point C_1, Fig. 2, is projected over to the helix *cc,* and its distance on horizontal line from center line VI is similarly set off on the same horizontal line, prolonged from IV, giving point C_1 of Fig. 3. Point D_1 of Fig. 2 is similarly projected over to helix *dd,* and its horizontal distance from center line VII is set off on the same horizontal line, prolonged, from center line IV, giving point D_1.



As the longitudinal distance parallel to the axis, from one tooth face to another, across the space, is the same on any given radius, the distance B_0—B_0 of the central section is obviously the distance from tooth face to tooth face for *all* the sections on circle *B,* and simliarly with all the other circles. Therefore from the points derived in the manner just explained, the distances A_0—A_0, B_0—B_0, C_0—C_0 and D_0—D_0 are measured off to the right from the left-hand points A_1, B_1, C_1, D_1, just obtained, and the corresponding section for the right-hand side of the tooth space for the No. 1 section is derived by drawing a smooth curve through them, as of course, has already been done for the left-hand side. In the same way sections 2, 3 and 4 are developed, corresponding to the section planes bearing the same numbers, there being no points D_4 on the No. 4 section because No. 4 plane does not cut *D* circle.

FINDING THE GEAR SECTIONS.

We have now a series of sections through the worm, parallel with the central plane, and we can take these as the spaces of teeth and develop the teeth which will mesh with them by the rolling method. This is most easily done by the use of a piece of tracing cloth, Fig. 4. First we draw, parallel with the center line of the worm, a line marked in Fig. 3, "Path of Gear Center," which is exactly the center distance of the worm and gear from the center line of the worm. On it we project up the tooth centers numbered in Roman numerals from I to X, those above being numbered to correspond with those below. It has been stated before, but it will do no harm to repeat for emphasis, that these center lines are exactly the pitch distance 3 inches apart.

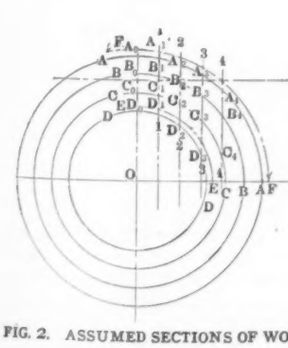


FIG. 2. ASSUMED SECTIONS OF WORM.

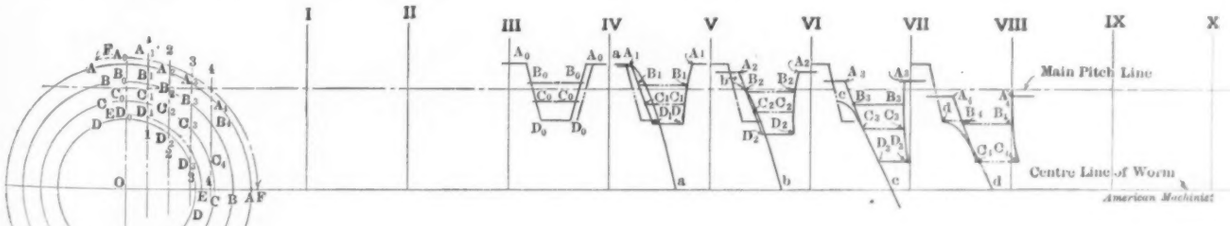


FIG. 3. OBTAINED SECTIONS OF GEAR.

On the tracing cloth, Fig. 4, we put a center and draw a portion of the circle of the same radius as the pitch circle of the worm, marked on Fig. 4, "Main Pitch Circle," and on this we locate a series of points the exact pitch distance apart

and draw radial lines through them. These are similarly numbered with Roman numerals from I to X. We now put the point marked on the tracing "Gear Center" on the line marked "Path of Gear Center," Fig. 3, and at the intersection of vertical tooth center I, at the same time putting radial line I to correspond with the lower center line I on Fig. 3. Then on the tracing cloth draw the side lines of tooth section $A_0 D_0 D_0 A_0$. This comes just to the right of radial line III on the tracing. Now put gear center Fig. 4 on line II and bring radial line II to correspond with this below. Draw on the tracing cloth the new position of tooth section $A_0 D_0 D_0 A_0$ and this time as section No. 1 comes within reasonable distance of the pitch circle we draw lines A_1—D_1, D_1—A_1 also on the tracing at the same setting, this bringing it to the right of tooth center IV. The next time the gear center and radial line III are made to coincide with vertical line III, and the sections 0, 1 and 2 are each drawn on the tracing. The next time section No. 3 is added, and the following time section No. 4. The process is thus continued until the gear center has passed so far to the right that all the tooth sections, if drawn on the tracing cloth, would be completely outside of the tooth spaces on the tracing, which have now taken definite shape. We now have apparently only to fit a curve to the series of lines drawn on Fig. 4 for each of the sections, so as to make what mathematicians call "an envelope," and we shall have what we started out to get, the gear tooth sections corresponding to the worm sections already developed; but just here we come to the necessity for more care than is apparent on the face of the returns.

On Fig. 2 there are drawn two dotted circles *E E* and *F F* which are respectively the point and base of the gear teeth, and by taking the vertical distances from the line "path of gear center" to the intersections with these circles of planes 1, 2, 3 and 4, we get the tops and bottoms of the tooth sections bearing the corresponding numbers. These are now added at their proper places on the tracing, Fig. 4.

Section *O* is obviously symmetrical, and we now take its center as a reference line and proceed to make a face view of the tooth of which we have developed a series of sections. We can obviously locate a center line corresponding to the one chosen on sections 1, 2, 3 and 4 by stepping off the pitch distance from the center of section *O*. Drawing radial lines through the points so determined, we get a base line which is equivalent to a plane passing through the center of the central section of the tooth, and through the axis of the worm gear. This, for convenience, we now keep with us. At Fig. 1, A is a face view of a tooth shown, based on the center line of the first tooth below the center. The way in which this is made, by simply measuring the distance of the top and bottom of the corresponding sections from the main center line and carrying them with dividers over to Fig. 1A, is obvious.

It should be stated for the guidance of others that arcs of the circles were chosen as the envelopes for the curves in the different tooth sections, and these were fitted to the tooth sections before this face view was made, the arcs being prolonged at the base to intersect with the base line of the respective sections. All reasonable care was employed in fitting these arcs to the sections, and they were then assumed to be the proper section; but when the points for Fig. 1A were taken from these, smooth curves could by no means be drawn through them; in fact, quite the contrary was the case, and it was necessary to do this work of fitting the arcs to the developed sections a second time with greater care and with due regard for which way the points involved must move in order to give a smooth section. It was found, when this was done, that the radii and base circles for these arcs formed a sort of series in which the progression was quite regular when the face view of the tooth finally became an area of smooth curves. It should be stated that the original angle of contact of the worm teeth was taken as 120 degrees, but this was done almost through inadvertence and

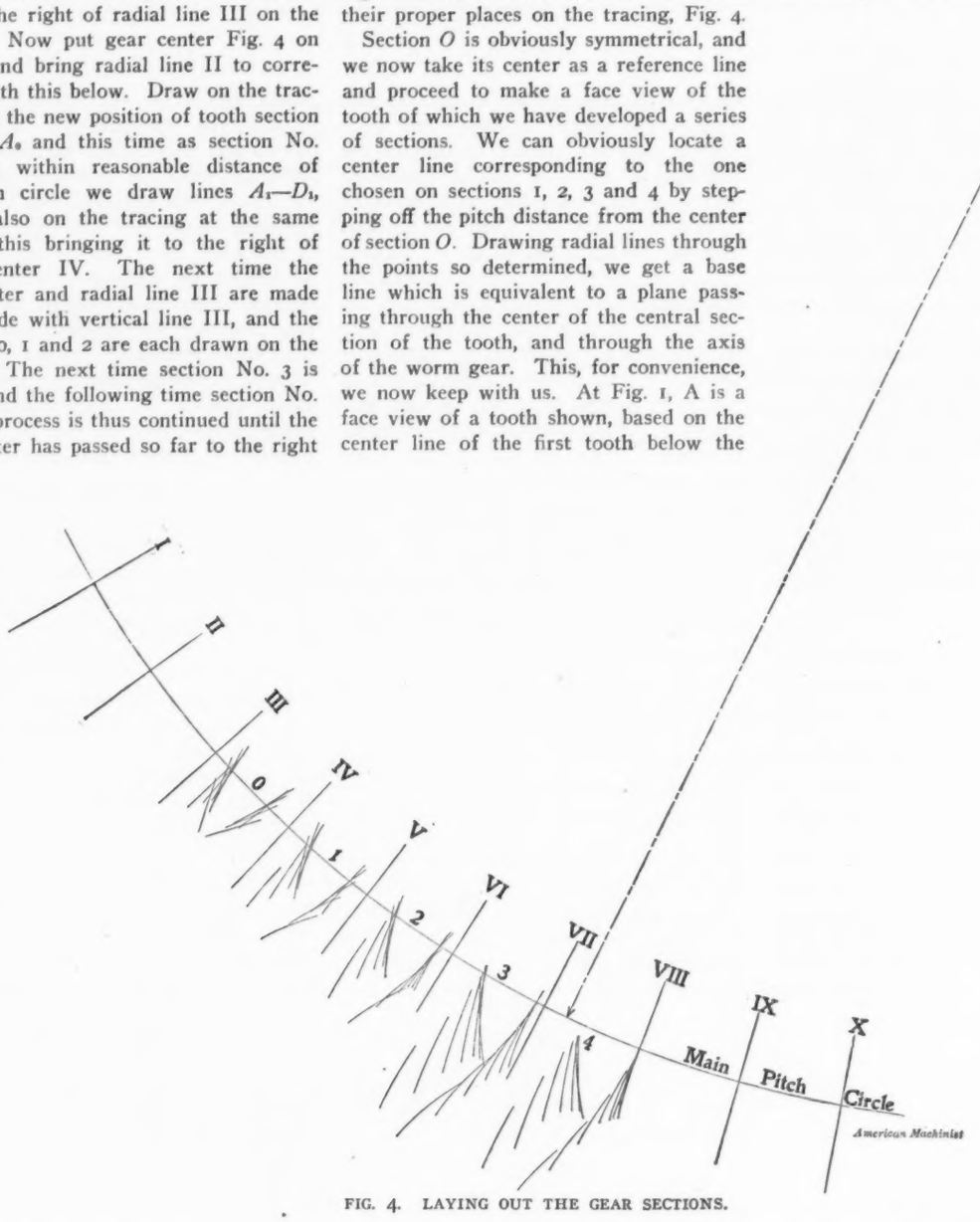


FIG. 4. LAYING OUT THE GEAR SECTIONS.

subsequently seen to be entirely wrong, being then reduced to 90 degrees, as shown; but before this was done a fifth section plane was used to get the base of the unnecessarily wide teeth given by 120 degrees contact angle. This section, No. 5, was actually not used at all.

LAYING OUT THE TEMPLETS.

Having now the corrected series of tooth sections, the question was how to translate them into something that the

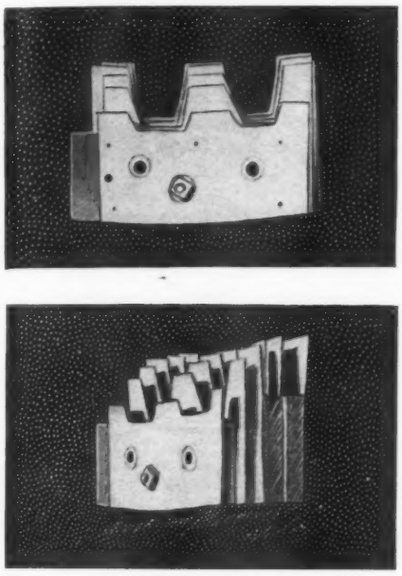


FIG. 5. THE TEMPLETS.

patternmaker could use to produce the actual teeth, and then how the teeth patterns so produced could be used to the best advantage in molding the gear. The solution is the only real novel portion of this article, and is comparatively simple. The sections 0, 1, 2, 3, and 4 were laid off on tin, with certain reference lines to enable the different tin templets to be properly located with relation to one another, and the individual templets were then stacked up with distance pieces of wood between them at the back end, and bolted together in their proper relative positions. The thickness of the distance pieces was made exactly the same as the distance between consecutive sections, less the thickness of the tin itself. The complete templet is shown in Fig. 5.

The method of laying out the tin templets was fairly convenient, and may, perhaps, be of interest. It is shown in the sketch Fig. 6. A T-shaped board was made with the top surface flush and smooth. A tin center for the beam compasses was put near the end of the stem of the T. The successive tin blanks, on which the sections were to be laid out, were placed at the other end. They were pieces of tin about 5 by 6 inches, and to hold them in place a small portion of each corner was bent down square about ½ inch and the points so made driven into the soft wood of the lay-out board. On the board, first of all, the main pitch-circle was drawn and radial center lines of two adjacent teeth (the pitch distance apart, of course, on the pitch circle). In addition to these lines a reference circle was drawn 4 or 5 inches larger in radius than the main pitch circle. The successive pieces of tin were fastened down on the board, the main pitch circle drawn on them and the center lines of the two adjacent teeth. Then, from the drawing, Fig. 1, as given herewith, the tooth sections were laid out, sides, top and bottom. The base circle and the center lines of teeth were plainly scribed on each templet, which was then cut out as shown by the heavy lines in the sketch, with the reference circle as a base at the back and the teeth in front. When these were done, it was only necessary to make distance blocks of the required thickness, curve the backs of all of them to the radius of the reference circle and scribe squarely across the backs thus made two lines whose distance apart was that of the two center lines of teeth measured on the reference circle. Then by stacking the templets and the blocks in their proper order, with the backs and these teeth centers corresponding, the templet was made which translated into solid form the sections whose development has been, I fear, so tediously described.

The teeth were whittled out and shaped to the templet until they fitted all its sections, smooth curves between being secured by eye.

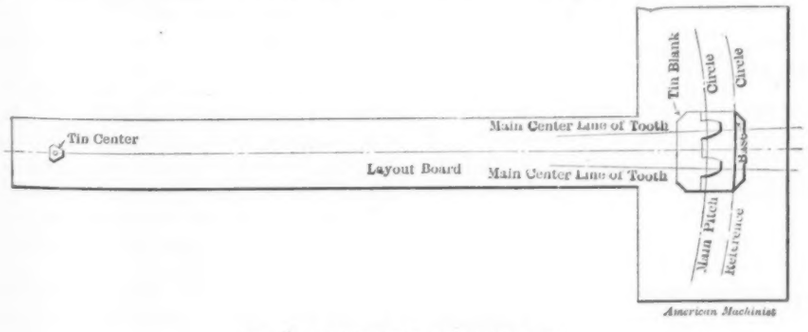


FIG. 6. LAYING OUT THE TEMPLETS.

The templet has the great advantage of visibility, all the sections being in sight between the sheets of tin. In spite of this the job was a tedious one, but good when finally done.

Two teeth were laid out in the templet, both as a check and because, when properly located in this way on the templet, the latter could be used to space the teeth around the wheel as well as to get them out. The templet did not give the whole length of the tooth, but only half, from the center out, as it was thought that having the central plane of the templet to work to, would enable the central plane of the teeth to be accurately located in the central plane of the gear, and for the practical reason that fitting anything to a solid templet of this kind is a job whose difficulty increases about with the

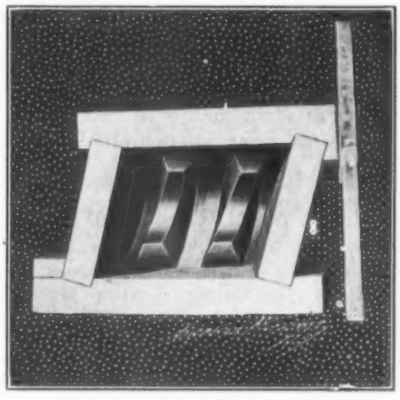


FIG. 7. THE CORE BOX.

cube of the size of the templet. As only one gear was to be made and that only a third of a circle, and as the whittling out of these teeth to fit the templet was a fearful job, it was decided to make the pattern so that the teeth would be made in a core-box, the sections of core being set around the rim of the gear in a way not unfamiliar in other classes of work. Accordingly, such a core-box was made containing two teeth, a photograph of it being shown in Fig. 7. Of course the gear pattern carried a core-print in rectangular form projecting out from it, as shown in broken and dotted lines on the axial section of the gear in Fig. 1.

THE RESULTS.

The patternmaker was entirely unused to work of this description, but came off creditably from it, the wheel being a first-class job as a casting, the cores coming out just right for length, and the time consumed on the job not excessive. The fit of the teeth in actual operation is about all that can be desired, with the single exception that the clearance was made greater than it need have been, and the back-lash is therefore slightly greater than it readily might have been. The wear of the teeth of the gear seems to be about as near uniform all over as it is ever possible to get cast teeth. The job is well suited for what it has to do, and the cost was less than that of cut gearing.

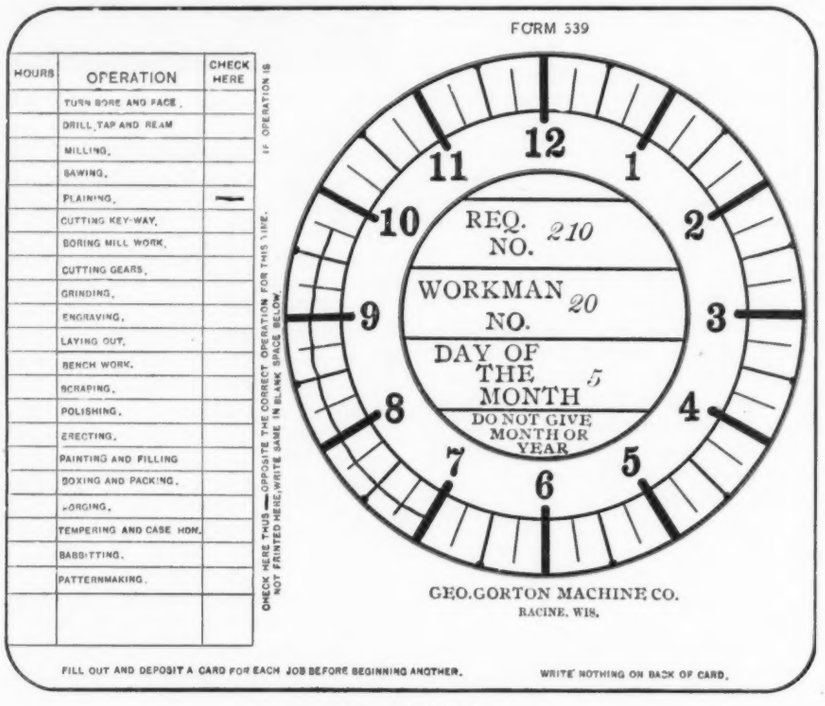
It is not to be denied that this process, as a whole, is tedious and requires a great deal of time. Even after the draw-

ing is made, it is not improbable that the draftsman will be required to lay out the tooth templets for the pattern-maker. In fact, unless the latter is exceptional, this is much the best way to do. The drafting work itself requires great care and accuracy, if decent results are to be produced, and it is doubtful if the best of draftsmen could put through such a lay-out complete in less than three or four days and get a satisfactory job of it.

With all that may be said against this method of making such gears, and no one knows better than the writer how much there is to be said of this kind, it may still be fairly claimed that for large gears, and especially for large pitches, where the probability of a gear-maker having the required hob and other facilities is slight, and where the conditions of running are such as to admit the use of cast gearing, there is still room for this process to be used with good results.

A Novel Time Card.

We illustrate herewith a new form of workman's time-card, which has been sent to us by the George Gorton Machine Company, of Racine, Wis. The method of filling out the card for any given job is obvious from the illustration.



A NOVEL TIME CARD.

It is natural for most people to consult their watch dials in order to determine the elapsed time between the events during a day rather than to make a mental subtraction, and the object of this form of card is to enable elapsed time in the shop to be determined in the same way.

The number of finishes which are now put upon metals to be used for ornamental work is so great that much confusion will sooner or later take place in designating them. The number of finishes which are made possible by the use of oxidizing solutions and lacquers is almost legion and almost every day we receive letters from platers who wish to know how a finish with an unknown name is produced. We usually send for a sample of the goods and afterward find that the finish is an old one under a new name. Each manufacturer has a different designation for his finishes, and in many shops the number has become so great that more or less confusion has taken place. In order to obviate this difficulty and leave no room for doubt when an order is given for a certain kind of finish, many of the manufacturers have adopted the practice of numbering the finishes and it is by these designations that they are known in the shop.

This practice is an excellent one and surely avoids confusion, but it is of no value to the outsider. If a prospective purchaser of a piece of fine metal work were informed that the article is known as No. 32 finish he would probably fail to purchase it, while a name such as Persian Verde might result in a quick sale. If there could be some uniformity in trade designations for finishes it would be very satisfactory and the matter of sentiment, which is so necessary in the sale of finely finished wares, would not be dispersed.—*The Brass World.*

This is a case in which it is very clear that sentiment must be appealed to in order to do business. Though it is not so clear in most cases where sales of machine tools are in question, it is nevertheless true that sentiment and individual idiosyncrasies do affect sales more or less.

Selecting a Molding Machine—Molding a Cone Pulley.

BY R. A. BULL.

There are many types of molding machine on the market to-day, each of them being designed for, and executing satisfactorily, a certain class of work. I know by experience that there is a place for each of them, but it is difficult for one with no experience in this line to select the right machine for his work, so usually he will seek the builders of the different machines, and perhaps find each one of them declares

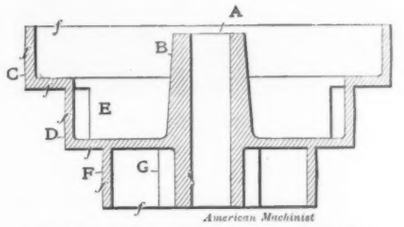


FIG. 1. CONE PULLEY TO BE MOLDED.

that his machine is especially adapted for his particular line of work. A trial of course will tell the story, but if the results do not come up to the expectation of the buyer, then the molding machine gets a black eye in that foundry.

There are molding machines for ramming the sand only, and there are jobs that it would not pay to do anything else with but ram; so for those jobs the ramming machine is just the thing. Again, there are jobs that could not be successfully rammed, but could be drawn out of the sand by the machine successfully. These jobs are those that have an unusually crooked form, but which must fit nicely in a jig to be machined; the crookedness makes them difficult to draw by hand by anyone save a very skilled molder, so the machine can be made use of to great advantage, especially where unskilled labor is to be employed. These jobs are especially adapted to a pattern drawing machine, and if they were mounted on any other type machine they would be a failure. There are numerous styles of patterns to be contended with in the foundries, some of which are difficult to work to advantage on the two previously mentioned machines, such as those that have a

green-sand core in the drag with very little supporting surface; this green-sand core, if one of the two previously mentioned machines is used, would have to be secured by a nail, not for fear of washing when pouring, but to hold it while the drag is being turned from the machine to the floor. The setting of a nail may not be objectionable if only one core is to be considered, but in case of a dozen cores, it would mean a considerable time in a day spent in setting nails, besides the wasting of them; this species of job can be best made on a type of machine called the roll-over, the patterns being mounted on a plate as a match-plate job would be, this plate in turn being mounted on trunnions revolving in bearings. The plate is turned with the patterns up, and, being secured in that position by a lock, the flask is set

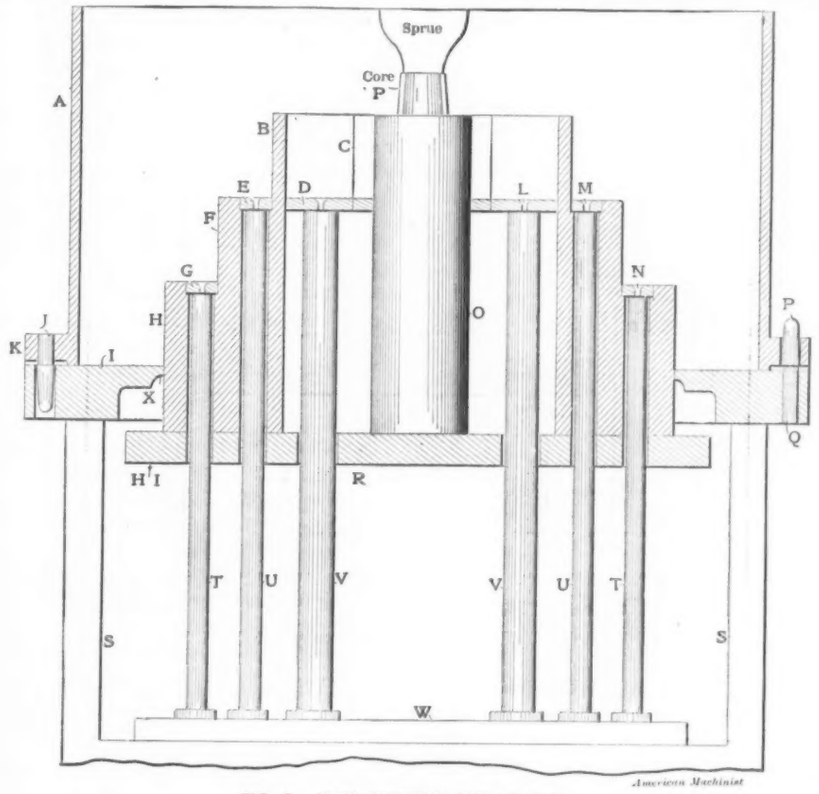


FIG. 2. COPE PATTERN AND PLATES.

in place and fastened to the plate, filled up and rammed. The table is then turned over and the flask let down on a table, through a special device on the machine, which action is accomplished with considerable speed. The cope is then set on the top patterns, which are on the opposite side of the plate, the sand being shoveled in and rammed, the cope merely being lifted off the plate, as it would be unnecessary to roll over the table, since the flask will not be turned. This type of machine is useful in more ways than one, as in case where the pattern has a specially bad place in it to mold, this section is favored by putting it in the drag and getting the benefit of the roll-over device. There are some few jobs, such as trolley wheels and sheave wheels, that would be made on a machine in a still different way, so as to avoid the three-parted flask generally used in this type of work. Such work as worm wheels or meat-cutter screws are generally made in such a fashion that they will screw down through the stripping plates out of the sand; and there are other pieces that one will come across in traveling through the country that will need a special machine to make them successfully.

So to a great extent success lies in starting right and using the proper machine and method of mounting the work. About as good a way as I know of to determine the correct way, is to go over all the likely molding machine jobs to be found in the plant, the likely ones being determined by the size of the order on them annually. After they have been picked out, the shape or the size should be looked after and brought systematically within as few sizes of flask as possible. Iron flasks are really the best, and many foundries throughout the country use nothing else, each flask being drilled through a jig and equipped with steel bushings and pins.

I will, for illustration, give a few questions that ought to be asked and answered by the purchaser before he buys a machine:

1. How important is the work, and has it much machining to be done to it?

2. Are there liable to be large orders on it?

3. Are there any deep pockets formed in the cope or drag?

4. Are there any long, slender cores of green sand in the cope or drag?

5. Shall you use iron or wood flasks?

6. What grade of sand do you use on this work?

If these questions are intelligently answered, then I am sure the buyer will be in good shape to determine which machine he needs for his work.

Sometimes the price of the molding machine is the first consideration with the buyer. This is where he makes a mistake, for as a general rule the cheap machines are very simple ones, doing very little of the work to be done in making a mold. Along with these simple machines come such statements as, "This machine will turn out fifty per cent. more work in a day than can be done by hand." This may be true in some very backward, slow foundry in the Philippines, but not so in America. Another says, "This machine has less parts to be exposed to the sand than any other machine on the marker," and many other statements are heard, which hit the cheap buyer as O. K., and cause him to send in an order for a machine, only to regret it when he sees the results of a day's or week's work.

MAKING A SPECIAL CONE PULLEY.

I will illustrate a 3-step cone with a special arrangement in it to be used in changing the speed of the feed of certain machinery; this special device involves an internal gear cast on the inside of the second step, while at the small end of the cone and within the small step there is attached to the hub a spur gear, these gears being thrown in to mesh by means of a lever at the side of the machine. A cast gear answers the purpose, providing it can be cast accurate and uniform, but if this be attempted by hand molding it will require a very skilled molder, which makes the cost immoderate, and, moreover, the chances are that his work will not show up uniform enough for the place in which it is to be used; so if it were not for the molding machine, a cast gear would be abandoned, but the machine will turn these cones out perfect. The only method that will give perfect satisfaction is the stripping-plate method employing a hand-rammed machine, such as shown in Figs. 2 and 3.

Fig. 1 is a plan and elevation of the cone to be made on machine.

Fig. 2 is a view of the cope machine, with the patterns and strippers in place.

Fig. 3 is a view of the drag sections of the pattern, also the stools and strippers for same.

The patterns being round in shape, an iron flask can be used to advantage; the flask is designated by *A* in Fig. 2. Each flask is well fitted and planed to rest level on the top of the stripping plate. The different sections of the pattern are made of iron, finished true in the lathe, especial attention being given to Fig. 2 at point *C* and Fig. 3 at point *I*, these being the teeth of the two gears.

The drag section of the pattern being set at such a low point from the flask line, makes it necessary to use a bar in the

flask to hold the sand when lifting and turning the drag from the machine to the floor. To mount this pattern, as shown in Figs. 2 and 3, proceed as follows:

MASTER PATTERNS.

As each iron pattern will, of course, need a master pattern, proceed to make one of the cope section as shown in Fig. 2, which consists of the center hub *D* and the outer faces of the three steps of the cone *B*, *F* and *H*. The recess at points *G* and *E* will not be put in the master pattern, but will be formed in the finishing of the iron pattern; the pattern should have an ample finish allowed for all over it. Make the master pattern of the drag section, which represents all the inside of the cone not taken in the cope pattern. As this section of the pattern extends far below the flask line, and the molding machine has a fixed and standard elevation for the pattern plate to rest on, which with this particular style of pattern comes above the bottom of the pattern, it becomes necessary to make the drag pattern and drag-pattern plate in one piece; this is accomplished by adding the flange *H*, Fig. 3, on the side of the pattern at the correct location to let the top of the pattern come flush with the top of the stripping plate when the pattern is finished, and setting in its place on the machine, the amount being suited to the make of molding machine employed. A finish is to be allowed on the under side of the plate or flange *H* and also on the remainder of the pattern that forms the inside of the cone. The core print is to be cast and finished as part of the hub *G* of the pattern. The recess that contains the stripper *J* can be cast in the pattern, a lathe finish being allowed on the inside, and the depth being made a little more than the thickness of the stripper *J*. The teeth *I* and *C* in both drag and cope can be omitted, as they will be made separate and fastened on when the iron pattern is finished to size. The manner of making the pattern for the teeth is to make a blank gear pattern and then a casting of it, and have the casting finished, cutting the teeth in a regular gear-cutting machine to insure that they will agree perfectly with the remainder of the pattern.

Next make one pattern which will serve for the two stripping plates *I* and *Y*, Figs. 2 and 3. Make the pattern for the pattern plate *H*1, Fig 2, for the plate *W* of same figure, which latter pattern will also serve for plate *N*, which is the same as *W*. Have all these patterns sent to the foundry for the necessary number of good castings, and have them finished as follows:

MACHINING AND FITTING.

First, start with the patterns by finishing them to size and shape desired, now cutting in the iron pattern, in both cope and drag sections, the recess that was omitted in the master pattern. The recess for the stripper *J* is cut deeper than the thickness of the stripper to preclude the grains of sand that may fall into it from interfering with the stripper's setting in its correct position when molding is being done. After the patterns are all finished, lay off the two stripping plates *I* and *Y*, so as to bring the center openings in them as true as possible with the outer edge of the plate, which is round; these stripping plates are merely rings; as they are not very wide rings it becomes necessary to make them thick so that they will retain their shape at all times. On two sides of each ring directly opposite each other there are cast as part of the ring two flask pin lugs; across the plate through these lugs scribe a line on both plates, and on these lines and within the lug locate a center for the flask pins; clamp the two plates together true with each other and drill the flask pin holes clear through the two plates; be sure the two center openings are as true as possible before drilling. Of course these plates must be finished on their top faces so that they will rest true together. The two holes for the pins should be large enough to take the largest pin bearing or bushing. Make two studs to fit these holes with a head on one end and threaded on the other end down to where the stud enters the plate, and put them in the two plates while together, putting a washer and a nut on the threaded end fastening the two plates securely together; chuck the plates in the lathe and bore the inside opening to the same diameter as the outside diameter of the largest step of the cone, just so that the patterns will slip freely through them with no play. With the use of the molding machine jig, one of which comes with a machine of the type as shown in Figs. 2 and 3, drill the plates to fit the molding machine. Then get out the stools and strippers for stripping out the center sections of the patterns; the stools can be made out of cold rolled steel and the strippers of sheet brass. In the center of each recess drill several ½ inch and ⅜ inch holes equal distances from one other all around the ring or the recess, then set the brass strippers in their respective places and with a scriber up through the holes just drilled scribe the location of them on the under side and in the center of these locate, drill and counterbore holes for bevel head screws as shown in Figs. 2 and 3. Set the rings or strippers back in again and determine the distance from the under side of them to the top of the stool plate, then get out the stools *T*, *U*, *V*, *Z* and *L*; when made set them in their places and with a scriber through the screw holes in the strippers, scribe the location of the holes on the end of the stools, remove the stools and drill and tap each stool for the screw to be used, then in the other end of the stools and in two out of each ring set drill screw holes. Set the stools in place again and locate the hole in lower end of stool on the stool plate; drill and tap the stool plate at these points for the screw being used. Take the pattern and drill out the ½ and ⅜-inch holes so there will be a clearance all around the stool sides, doing this drilling while the pattern is fastened to the pattern plate, and run the hole clear through the pattern and pattern plate.

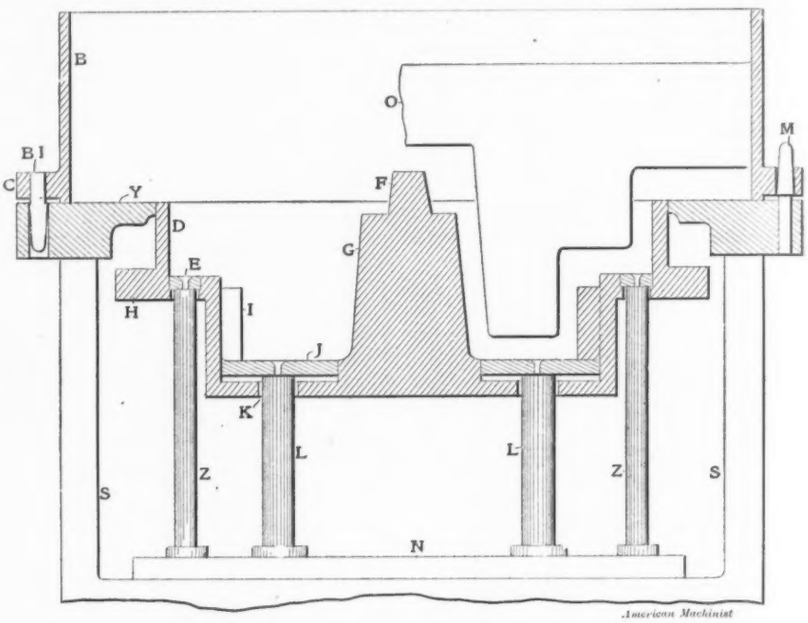


FIG. 3. DRAG PATTERN AND PLATES.

THE FLASK.

Set all the parts in place on the machine and go about getting out the flask by getting the flask-pins and bushings made; drive in a set in the stripping plate and the remainder in the flask when finished. These flasks, as I said before, are finished on the bottom and drilled with a jig. A wood pattern should be made of the flask, then an iron one from that, this iron flask being well finished and a fol-

low-board made for it. The flask-pin lugs are elevated about a quarter of an inch above the finished edge of the flask. When the flask is finished set it on the stripping plate and determine the distance from the core print on the top of the cope pattern to the top of the flask, and then make a sprue, as shown in the cut, about 1-32 inch shorter than the determined length, or, in other words, have it, when finished and setting in place ready for molding, come a little below the top of the flask, so that when the sand is scraped off the scraper will not hit the sprue, yet the sprue can readily be located; the end of the sprue that rests on the core print is to be made about 3-16 of an inch on a side larger than the end of the print, and from this same end drill a ¼-inch hole clear through the length of the sprue, directly in the middle; then going back to the pattern again, drill in the center of the core print a similar ¼-inch hole for a dowel pin. Make a pin and drive it in this hole; the pin must fit in the hole in the center of the sprue. On the sides of the core print, on the cope pattern only, make and fasten three feeders equally distant from one another; these feeders are about ⅛x½ inch at the point that comes against the hub, while the other end is 3-16x⅜ inch; this leaves plenty of draft, so that they will not tear up the sand. In the drag section of the flask put the bar, as shown in the drag drawing, which completes the job.

MOLDING.

In making a mold from this set of patterns, proceed as follows: Set the flask in place on machine, fill in with sand, putting facing around the pattern teeth and tucking it securely around the bar, especially around the pocket; fill up the remainder of the flask with heap sand and ram in the usual way; then by a turn of the crank at the side of the machine the pattern will be drawn down through the sand, stripping plate and strippers. Lift the mold from the machine and set it on the leveled floor. Put on the cope, set in the sprue and proceed as with the drag; when rammed, lift it from the machine and set in on the top of the drag. Repeat this procedure as often as necessary to make the required number of molds. After this, the only thing to take into consideration is the weighing and pouring of the mold; this is easily regulated, so as to result in the turning out of very uniform castings, which, after going through the sand-blasting room, will look as pretty as a picture. As the outside of the cone steps must be finished, a jig is made that secures the casting by the teeth; this brings each finished casting true with the teeth.

When the long-distance wire now being laid between Denver, Omaha and Kansas City has been completed, there will be a direct telephone communication between New York and San Francisco.—*Mechanical Engineer.*

Machine Molding—IV.*

BY G. P. CAMPBELL.

The class of machine molding herewith described is that in which all ramming is done by hand and the lifting by a hoist, although the work is not so heavy that it cannot be done by hand if no hoist be available; but the hoist is quicker and will give better results in many ways.

THE FLASK.

The flask used for this casting is shown in Fig. 1. It has two pins in opposite corners at *A* and corresponding holes at *B* for the other half of the flask. It has trunnions at each side, and eight ⅝-inch holes for ½-inch rods which take the place of bars, making ramming easier, and yet they hold the mold firmly.

No bottom boards are used; strips of gray-iron are sunk level in foundry floor, and on these the flask rests; this does away with all wedging of rickety bottom boards.

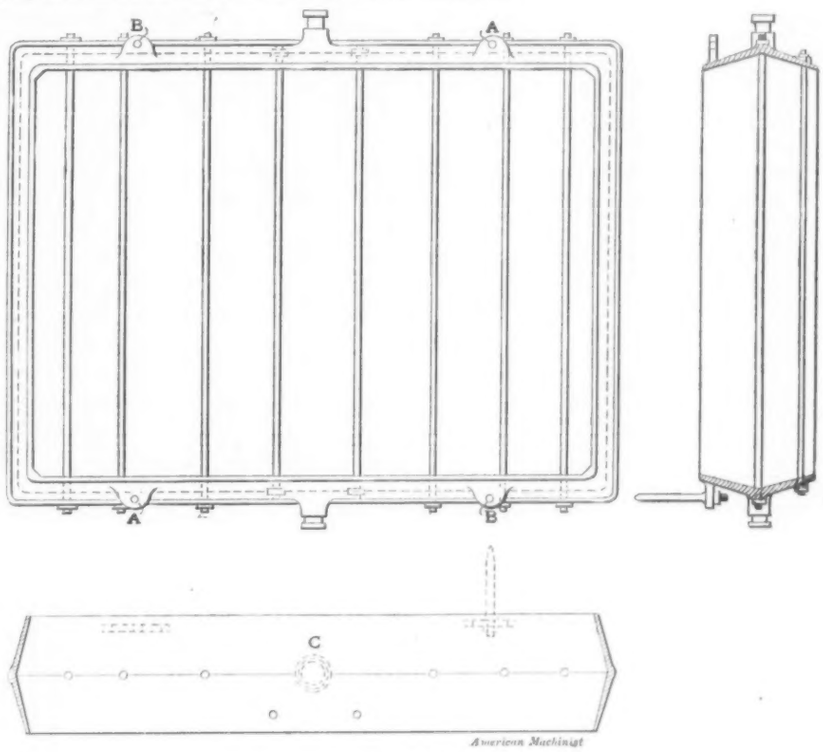


FIG. 1. THE FLASK.

The flask shown is about 7 inches deep, 24 inches wide and 36 inches long, the flare to the center being ¾ of an inch in 3½ inches, or half the depth. This holds the sand perfectly, and for some work will do without using either rods or chuck.

THE CASTING TO BE MADE.

The casting now to be made is shown in Fig. 2; its web is ⅜ of an inch thick, as shown in section at *D D;* the longer hub *E* at the top is 9 inches long; this is cored out, as shown in dotted lines, so that when it is bored for a bronze bushing it is only necessary to bore through the two ends, the drill not touching the center; this also lightens the casting. After boring the hole, a bushing is driven in and both ends finished. A short shaft runs in this bearing, oil holes being put in top and an oil cup (not shown) screwed on. There is one foot on the side and one on the bottom, the side bolting on a cylinder, the bottom on a bed-plate. A balance wheel is keyed on this shaft at side *E*, a crank being keyed on the end of the shaft. The lower hub *F* is for a crankshaft, which is connected to the upper one by a link, not shown.

This casting is about 14 inches wide, 18 inches high, and weighs about 70 pounds; 3-32 of an inch is allowed for finishing on all finished parts.

THE PATTERN AND MOLD.

Fig. 3 shows the pattern on molding machine.

Fig. 4 is a vertical section on the line *G G*, showing the pattern up.

Fig. 5 is a vertical section at right angles to Fig. 4 on the line *H H* with pattern up.

Fig. 6 is the same, except the pattern is down, showing stripping plate *N*, stool *O*, etc.

Fig. 7 is a section at right angles to Fig. 6 on the line *G G*, with pattern down, showing the different parts.

Fig. 8 is a section on the line *I I* of the mold complete.

Fig. 9 is a section of the mold at right angles to Fig. 8 on the line *J J*, showing gates and runners, and cores in place, all ready to pour.

*Copyright 1905. For previous articles of this series see Part Two of 1904 Volume, pages 993, 1092 and 1287.

In Figs. 3, 4, 5, 6 and 7 the following letters designate the same relative parts in the several views:

E. Half of pattern, short hub side.
F. Half of pattern, long hub side.
K. Runners.
L. Gates.
M. Frame of molding machine.
N. Stripping plate.
n. Cleats on same.
O. Stools.
P. ⅜-inch stripping piece.
Q. Pattern plate.
R. Bolt for same.
S. Draw plate.
T. Stool flange.
U. Stool pipes.

stools are used. The parting line on the machine for this pattern is just the same as when the mold is made on the floor with either a split or solid pattern, being at the center of the web; the heavy part of the casting, when molded on the floor, going in the nowel; but this is in a way reversed on the machine, one-half *E* being in the cope on one side and the other half *F* in nowel on the other, two castings being made in each flask, both cope and nowel being alike except gate-pins are put on when ramming up the cope side.

The runners are shown at *K K*, Fig. 3, and gates at *L* in same figure. This brings the runners at one end and gates at the other, and does away with the bother of changing gates for one side and having none for the other. When the cope is placed on the nowel, the two runners *K K* are on the top on one end and on the bottom on the other end. The gates fit close to the pattern, and as both gates and runners are screwed fast to the stripping plate, there is less danger of their being lost or broken.

In order to insure accurate work, it is absolutely necessary, in mounting the pattern on the molding machine, that the frame of the machine be perfectly square.

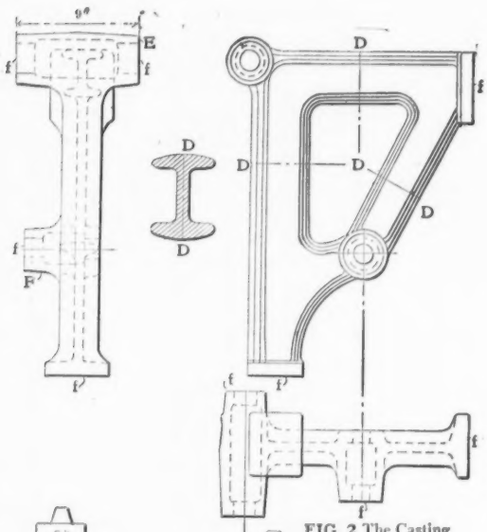


FIG. 2 The Casting

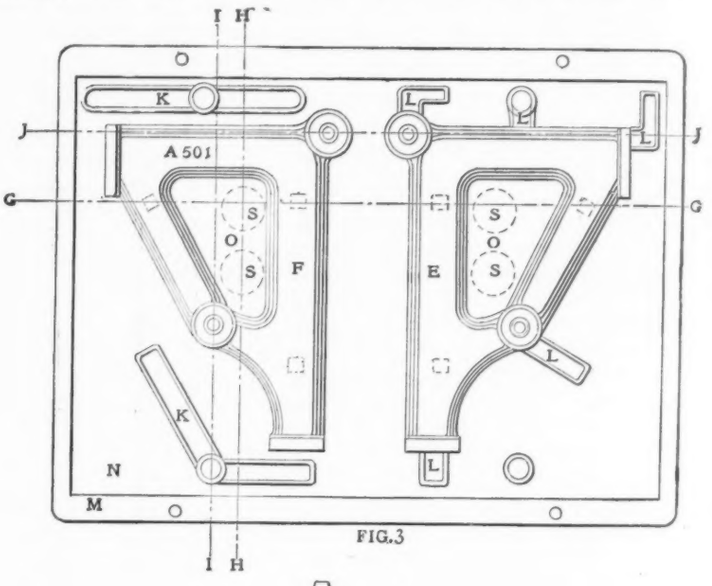


FIG. 3

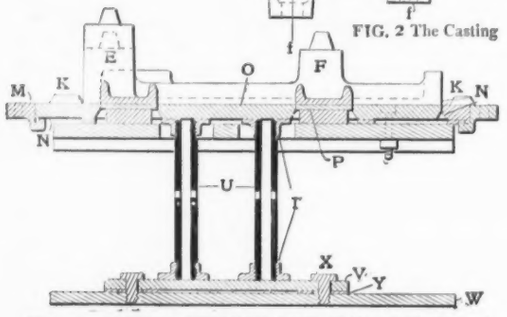


FIG. 5. SECTION THROUGH LINE H-H, PATTERN UP.

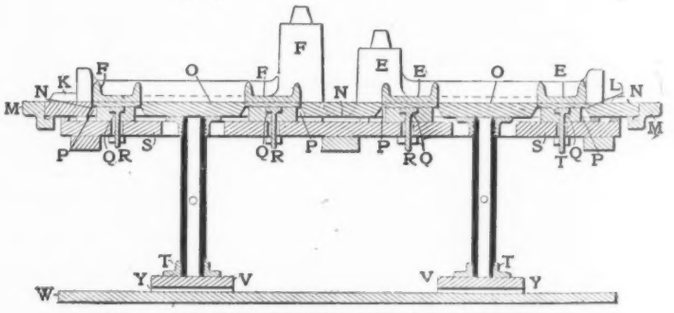


FIG. 4. SECTION THROUGH LINE G-G, PATTERN UP.

V. Stool board.
W. Foundation plate.
X. Machine bolt.
Y indicates a strip of ¼x1 inch iron screwed on bottom of stool board *V* to prevent wear from contact with iron foundation plate *W*.

The pattern, stripping plate, stools, pattern and draw plates are of wood. The molding machine frame *M*, Figs. 3, 4 and 5 is gray iron; flanges *T* and foundation plate *W* are gray iron also; stool pipes *U* are of 1-inch pipe, threaded at both ends, right- and left-hand threads.

As it is necessary to change the machine each day for other patterns, considerable time is consumed setting up the machine for different patterns, especially where

MAKING AND MOUNTING THE PATTERN.

In making this class of pattern where the thickness of the web is small, in this case ⅜ inch, one-half of which is 3-16 inch, it will be found advantageous to use stock that will make the half of the web and the ⅜-inch stripping piece in one, which in this case would be 9-16 inch.

The frame for this should be halved together or else put together with a slip tongue and glued well. The 1⅝-inch draw plate *S* should also be put together the same way; the stock for the web should be dressed to a uniform thickness of 9-16 inch, the pieces screwed together and shape laid out together, with center lines where the hubs come. A 1-inch hole is bored through both pieces exactly on center where the hubs are located. Corresponding pins to fit these holes should be turned on the bottom of the hubs. This will locate the hub without any further measuring. The web pieces are now cut, and the edges made perfectly square, and to the correct shape as laid out.

The two pattern plates *Q* are now also made a uniform thickness of 1⅝ inches and fastened together. The 9-16 inch web pieces are laid on top of the two draw plates *Q* and the entire outline of the web marked in lead pencil on one side. The pattern plates are now cut to shape on the band and jig saws, cutting back 3-16 inch from the line so that the web will project that distance all around when both are put together. Three ½-inch bolts are then put in each draw plate, their heads being let in as shown at *R*, Fig. 4.

The stripping plate *N* having been previously made, halved at the joints, well glued and screwed together, is now fitted to the frame *M* of the machine, so that it will just drop in, so no fastening is required.

In laying out the outline of the half patterns *E* and *F* the feet at the top, as well as the hubs, should be an equal distance from each end; similarly, the feet at the bottom should be an equal distance from the sides.

The web pieces for each half should now be laid in place on the stripping plate, and a straight-edge should be laid across the feet at bottom of stand; another straight-edge, cut away where the hubs project, should be laid against the top. When both are located, a 1-inch hole is bored through each hub and the patterns are reversed to see if correct. Of course, the holes in the machine frame is a flat pine board, 1⅜ inches thick, with cleats screwed on the bottom, having the joints open 1-16 inch to prevent warping. Holes are cut out for stool flanges *T*, and draw plate is laid on the sliding carriage of machine (not shown); four ½-inch holes are bored to fasten to carriage, bolts put in and screwed up tight. The stripping plate *N* is now placed in the frame of machine and the lever of the machine is operated, lowering the draw plate so that the bolts *R* in pattern plate rest on the draw plate. Each half-pattern is put in place and a block of wood is placed on the pattern over each bolt in pattern plate and lightly tapped with a hammer; each half-pattern removed from machine and three ⅞-inch holes are bored in each end of draw plate for the ½-inch bolts *R;* the patterns are again put in the machine and bolts screwed up fast.

on the bottom of draw plate and foundation plate taken out. Four holes are drilled and tapped for ¾-inch bolt *X*, and the foundation plate is then put back in machine, stools lowered into place and the four ¾-inch bolts *X* are put into the stool-board and the bolts screwed up.

The pattern is again dropped, as in Figs. 6 and 7, and the face of stripping plate and stool made perfectly level. All bolts are now screwed fast and machine is ready for use.

All plates, patterns, etc., should receive three coats of varnish.

MOLDING.

Two men and a helper operate this machine, the hoist being operated by the helper. The patterns are raised, as shown in Figs. 4 and 5, and are thoroughly brushed off before each flask is placed on the machine. Parting sand is thrown loosely on the patterns and the entire face

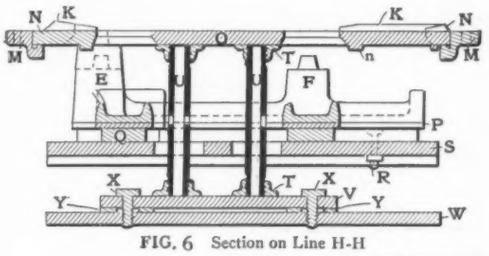


FIG. 6 Section on Line H-H

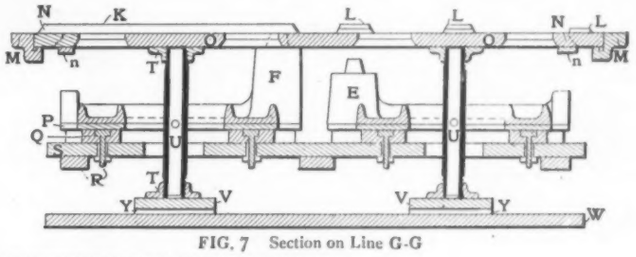


FIG. 7 Section on Line G-G

MOLDING MACHINE WITH PATTERN DOWN, SHOWING STOOL

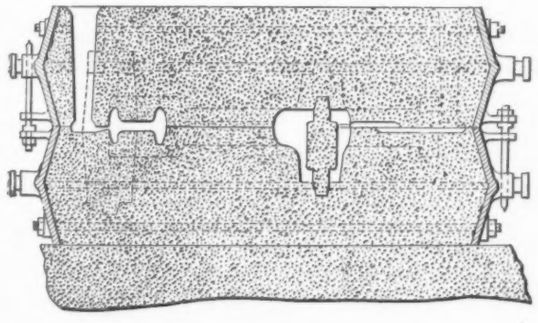


FIG. 8 Section through Line I-I

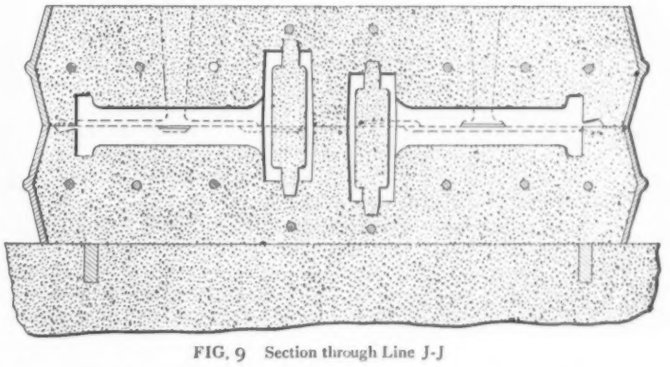


FIG. 9 Section through Line J-J

MOLD COMPLETE, READY TO POUR.

American Machinist

M for the flask pins must be equal distances from the ends also. The outline of the web is now scribed on stripping plate and cut to within 1-16 inch on the jig saw, and afterward cut to the scribed line with a paring chisel. The entire edge of the hole is now beveled 30 degrees, as shown at *N*, Fig. 4. The pattern should be a nice fit in the hole in stripping plate and reverse accurately. Cleats *N* are now screwed on bottom of stripping plates.

The web patterns are now bored for wood plugs and screwed from the top to the draw plates and holes plugged, and hubs, ribs and feet put on and pattern finished; all being well varnished. Runners *K* and gates *L* are now screwed fast to the stripping plate.

The draw plate *S*, shown in Fig. 4,

The stools *O* having been previously made and fitted to pattern, and also beveled same as edge of stripping plate, two flanges *T* are now screwed on each of the stools, the pipes screwed in, bottom flanges put on and a 13-16-inch hole is bored about 3 inches from each end of stool-board *V* for the ¾-inch machine bolts *X*. The stools are now placed in holes at middle of patterns and patterns lowered. A straight-edge is then laid across stripping plate *N* and stool *O*, and pipes adjusted, making stools level with top of the stripping plate, after which pattern is again raised through stripping plate.

The flanges *T* are now screwed fast to stool-board *V* and holes for bolts *X* marked; the stools are then raised through pattern, fastened up with a cleat

of mold and a brush run around where the flask is to rest on the machine frame. The flask is placed in position, sand riddled well over the face of mold and pattern until they are well covered; a vent wire is now placed on the top of each core print, sand is shoveled in, tucked in well and all well rammed up, a rammer with a rubber tip being used to prevent injuring the pattern. Before striking off the vent wires are, of course, removed. One man operates the lever, withdrawing the patterns through the stripping plate, as shown in Figs. 6 and 7, the flask not being shown in these figures. The flask is now raised from the machine, turned over and placed on the floor, and the mold is blacked by the helper, no other finishing of the mold being required.

The pattern is again raised to its place and brushed off as before; gate pins are put on for cope and operated as before, the sand rounded off around the gate pins and they are withdrawn. The pattern is now lowered through stripping plate and cope lifted off, turned over and blacked. The cores are placed in the nowel and the mold is closed ready for pouring, as shown in Figs. 8 and 9. A disk of ⅛-inch asbestos, about 8 inches in diameter, is placed over opening in the mold to keep all dirt out.

After the flasks are emptied out at night, the night men put the flasks together convenient to machine for further use.

When pouring off, a covering of some sort should be placed over the pattern on the molding machine to prevent burning by flying sparks. Some foundries use canvas painted with asbestos paint, and in others a sheet-iron case is hung from the wall on a rope and the top of the machine covered with it when not in use.

On small-gear work in one foundry I know of where a molding machine is fitted for special work with iron patterns and stripping plates, a small pan is arranged underneath and filled with kerosene, in which the pattern is submerged when it is lowered; thus the pattern is kept doped ready for instant use without swabbing it by hand.

The use of rods in a flask instead of bars is of great advantage to the night men and is greatly appreciated by them; furthermore, no time is lost the first thing next morning waiting to have new bars put in by the man whom everybody in the foundry wants as soon as the whistle blows at 7 in the morning, namely, the helper.

Competitive Test of Water Meters.

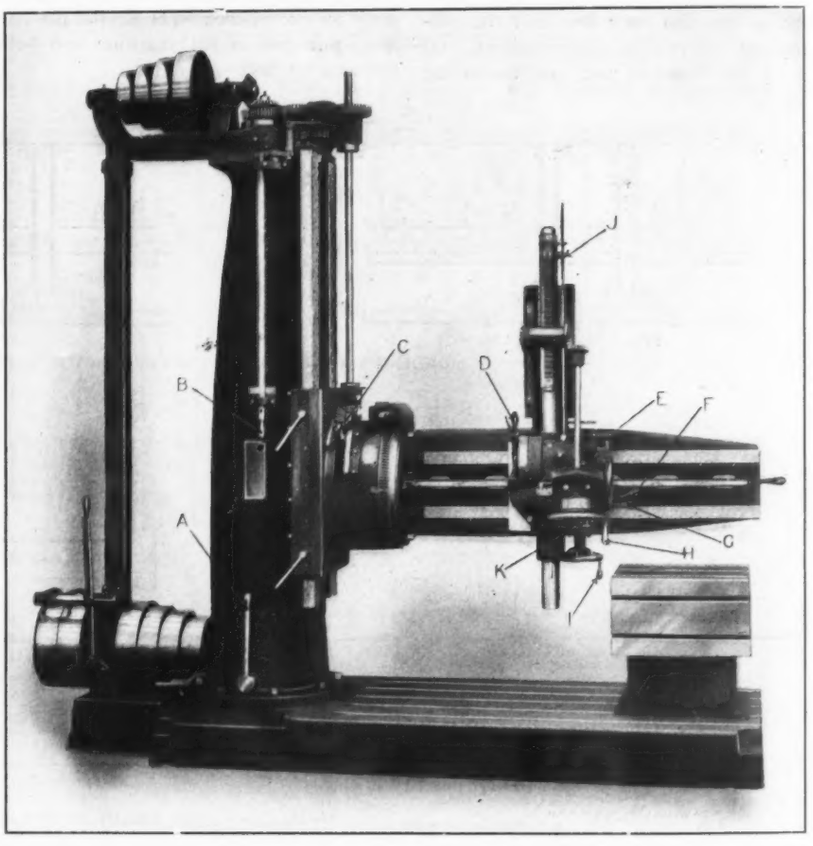
The Société Francaise des Habitations a Bon Marché are organizing an international competition between cheap and reliable water meters suitable for use in industrial dwellings, where they consider them to popularize a greater use of water. The meters should be capable of standing without leakage a head of 150 meters (492 feet), should indicate with a flow of 3 liters (⅔ gallon) per hour, and be capable of passing 235 liters (51.8 gallons) per hour, with a loss of head of not more than 2 meters (6.56 feet). The maximum error must not exceed 5 per cent. in the case of a flow of more than 60 liters per hour, but for smaller flows it may be 30 per cent.; but the error must always be in favor of the consumer. No meter which fails to meet this condition will be allowed to enter for the second series of tests, in which 500 cubic meters (1,102,000 gallons) will be passed through at different rates of flow, and at the end of the trial the meter will be again tested for accuracy and absence of leakage. Further information can be obtained on application to the Société, at 4, Rue Lavoisier, Paris.—*Engineering.*

A Universal Radial Drilling Machine.

The illustration shows a 5-foot universal radial drilling machine, having features of interest.

The inner column—which carries the outer column upon cone-shaped roller bearings—runs to the top of the column, where it is fastened to the housing, which in turn is secured to the rear brace, giving extra support to the column.

The arm has the usual revolving motion operated by worm and gear and can be clamped in any position desired. The spindle is counterbalanced, and is easily manipulated in any position. All handwheels and operating levers are within easy reach and so arranged that one cannot conflict with another.



A UNIVERSAL RADIAL DRILLING MACHINE.

With the cone drive, as shown in the illustration, this machine has 12 changes of speed and 6 changes of feed; the speeds are increased to 18 when using speed-box drive. The speeds and feeds are arranged to conform with modern drilling practice.

The lever *A* operates the column tightener, which holds the arm in any position desired. The lever *B* operates the elevating device. The lever *C* furnishes 3 changes of speed to every cone or speed-box speed; while the lever *F* controls the forward and reverse frictions. The handwheel *H*—with the nurled knob *K*—allows of quick adjustment of the spindle. The lever *D* operates the positive power feed. With the hand-wheel *G* the feed can be operated by hand. The levers *J* and *E* are the depth gage and automatic stop, which prevent feeding a greater distance than required. The hand-wheel *I* operates the longitudinal movement of the drilling head.

The maximum distance from the column to the center of the spindle is 61 inches, the minimum 20 inches, which allows 41 inches travel of the drill head upon the arm. The maximum distance from the spindle to the base is 62 inches, with 44½ inches vertical travel of the saddle on the column. The spindle has a travel of 18 inches and is bored to fit a Morse Taper No. 5. The speeds range from 16 to 360 revolutions per minute, while the feeds range from .007 inch to .0465 inch per revolution of the spindle. The weight is 10,500 pounds.

This machine is built by the Fosdick Machine Tool Company, Cincinnati, Ohio.

Employment of Children in Germany.

Consul Muench, of Berlin, Germany, in the *Daily Consular and Trade Reports*, states that the new legislation there against infant labor has not given the good results expected, for, though it is easy to control child employment in factories, etc., there is great difficulty in regulating "home work." The reason for this is that a close espionage by the truant officers upon the movements of children in their own homes is likely to lead to a

habit of deception and prevarication by both parent and child, as well as to weaken the desirable confidence between pupil and teacher.

It is feared that the new law may have done more harm than good, inasmuch as it has led to new phases of infant labor, as at Danzig, where 489 children, from six to fourteen years of age, were employed at their homes platting cane for chair seats for a wooden-ware factory; and where 42 per cent. of a large number of school children were deprived of their freedom during their noon and afternoon recess and after 8 o'clock at night, thus compelling the little unfortunates to perform the double duty of attending school and contributing to the support of the family.

In view of these results, it is considered that it will be necessary to pass additional legislation, aimed at this work in the home; also to improve the school facilities and make the schools free to as large a proportion of the working people as possible, and thereby remove one excuse for obliging the children to work.

Letters to the Editor.

The Accident to the S. S. "Athos."

I wonder how many of the readers of the AMERICAN MACHINIST, after reading of the misfortunes of the "Athos" (the fruit steamer which was towed into port recently 14 days overdue), have any idea of the strenuous life led by the engineers of such a boat.

The round trip, voyage in and voyage out—except when a godsend in the way of a break-down gives them a few weeks in port—is monotonously the same.

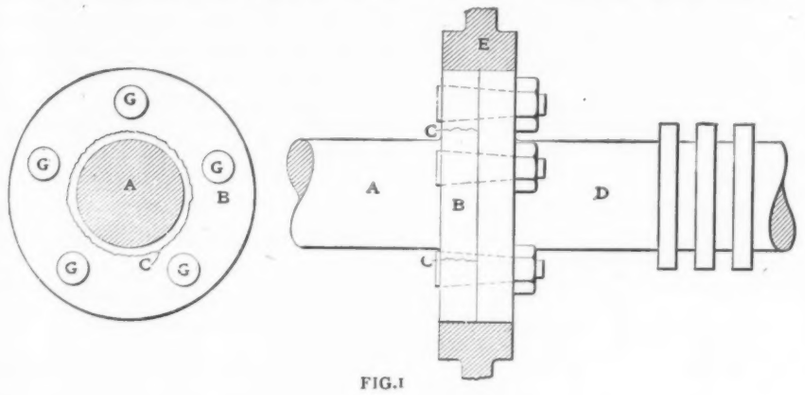


FIG. 1

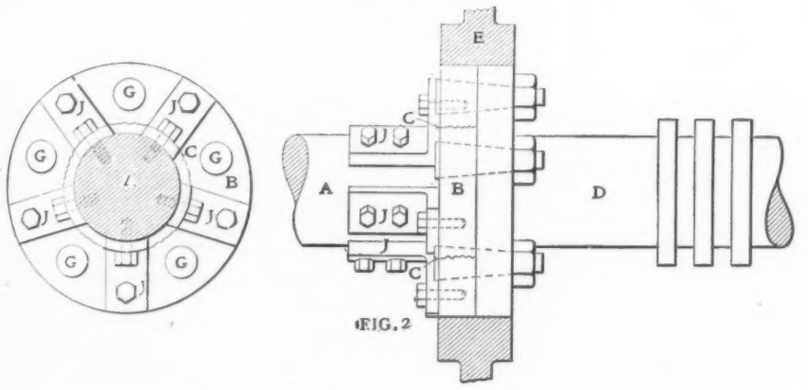


FIG. 2

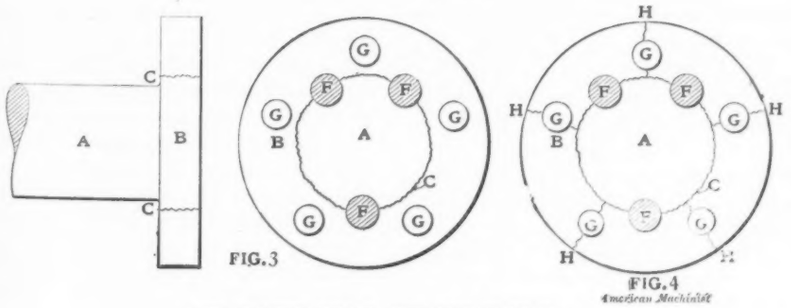


FIG. 3 FIG. 4

American Machinist

THE BROKEN SHAFT AND THE REPAIRS.

Twenty-four hours suffices to discharge the cargo in New York. As soon as the cargo is out, off she steams to Jamaica. Arriving at Port Antonio the negro stevedores are taken on board and away she goes round the coast picking up cargo here and there, then back to Port Antonio, where the stevedores go ashore. From the time she takes the stevedores on till she discharges them again, 12 to 15 hours later, she has called in at and received cargo from as many as 10 different ports, with the engines working most of the time and steam up all the time. This loading is done at night, as the bananas are cut during the day. The only time that any repairs can be made is during the 24 hours in port in the United States.

The engines of the "Athos" are triple expansion, their size is immaterial to this story; suffice it to say that they are—although the average landsman would not notice it—a trifle smaller than the engine-room in which they are installed. The back ends of the boilers are separated from the engine-room by a thin layer of boiler covering only.

The high and intermediate cylinders are equipped with Hackworth's single eccentric valve gear. On the bases of the forward and middle column brackets are secured, which are a part of the Hackworth valve motion. The low-pressure cylinder is equipped with the ordinary Stephenson link motion.

Homeward bound from Port Antonio the forward or high-pressure eccentric strap broke; this carried away the two brackets on the base of the forward column. There was no spare eccentric strap and so it was decided to blank off the high-pressure cylinder and run compound with the intermediate and low-pressure cylinders. As part of the intermediate valve gear worked in one of the broken brackets, the bracket was shored in place and the "Athos" proceeded on her way under reduced steam. They were hardly started before the after coupling on the crankshaft gave way. *C* at Fig. 1 shows the location of the failure, which I venture to say is probably without a parallel.

A is the after end of the crankshaft, and *D* the forward end of the thrust shaft. *E* is a section of the hub of the turning gear. The turning gear is a worm wheel securely keyed on the two flange couplings of the crank and thrust shafts; by throwing a worm into gear with it the engines may be turned to any desired position and held there, when making repairs.

When the crack occurred at *C* the shaft *A* turned in the flange *B;* the thrust shaft *D*, with the attached coupling flange *B*, gradually coming to a standstill, as the ship lost way.

As soon as steam was shut off, the repair shown in Fig. 2 was made. It consisted of five brackets *J* secured to the shaft *A* and flange *B*—between the coupling bolts *G*—by means of cap-screws 1¼ inches diameter. This repair held for about half an hour.

The final repair, shown at Fig. 3, was then made. The thrust shaft was disconnected and lifted out of the way. Three 3-inch holes were drilled at *F*, half in *A* and half in *B*. Three pins were driven tight in these holes and cut off flush. The thrust shaft was then put back in place, the coupling bolts put in and the turning gear *E* put back in place on the flanges. The key of the turning gear was driven up with a heavy sledge and the

job was finished. This time she steamed 250 miles. About 12.30 one afternoon, while the donkeyman was below—relieving the engineer so that he could get his dinner—the turning gear, which was supposed to be immovable, slipped off and the next instant the coupling flange B fell in five pieces, cracked through the bolt-holes G, as shown at H, Fig. 4.

Six days and six nights in the stifling heat of the engine-room, with hardly any rest, the engineers of the "Athos" worked away at the repairs only to have them fail one after the other. But men like these make the merchant marine what it is. With few tools—a ratchet brace, hammer, chisel and forge—and an unlimited supply of energy and know how, they do things that the average landsman or their brethren in the navy would deem impossible. It is safe to say that but for the slipping of the turning gear when it did, the "Athos" would have come into port under her own steam. DIXIE.

A Spiral-Gear Transmission.

Some time ago the writer had occasion to gear up two shafts standing at an angle of 11 degrees with each other and 6⅝ inches apart, the ratio of rotation being as 17 to 12. A third shaft with four bevel gears could be employed, but it appeared simpler to use two spiral gears. The framing of the machine was such as to necessitate making both gears of nearly the same size. The accompanying drawing shows the angle of the shafts. The shortest distance between the centers is perpendicular to the plane of the paper. After sketching the two gears in outline and making them of the same diameter, it became evident that a line EF (shown dotted behind the gear on shaft CD) would illustrate the angle of the tooth that was working and common to both gears. It also became evident, from an examination of the sketch, that as the gear on shaft AB was to rotate slower than the gear on shaft CD, the ratio being as 12 to 17, the angle of line EF with AB must be less than angle of EF with CD. Therefore the tooth angle should be as shown instead of sloping in the opposite direction. The pitch diameters of the two gears are to be almost equal, the normal pitch is to be the same, and therefore the circular pitches will be in the ratio of 17 to 12. The circular pitch of gear G must, of course, be

$$\frac{\text{Normal pitch,}}{\cos.\ EOA} \text{ and of gear } H \frac{\text{Normal pitch}}{\cos.\ EOC}$$

The pitch diameters of the gears are to be substantially equal; therefore

$$\frac{17 \times \text{normal pitch}}{\pi \cos\ EOA} = \frac{12 \times \text{normal pitch}}{\pi \cos.\ EOC}$$

which reduces to

$$\frac{17}{12} = \frac{\cos.\ EOA}{\cos.\ EOC}$$

Now, angle EOA is 11 degrees less than angle EOC. Setting my slide rule at $\frac{17}{12}$, and consulting a table of natural cosines, a hunt of five minutes shows that cos. 55 degrees is 0.5736, and cos. 66 degrees is 0.4067, being the nearest cosines in my table, 11 degrees apart, to the ratio 17 to 12. I never attempt to divide finer than ¼ of a degree, or the boy on the universal milling machine would have a good cause for fault-finding. In this case the equation for unchanged center distance would read:

$$\frac{NP \times 17}{\pi \cos.\ EOA} = 2 \times \text{center distance} - \frac{NP \times 12}{\pi \cos.\ EOC}$$

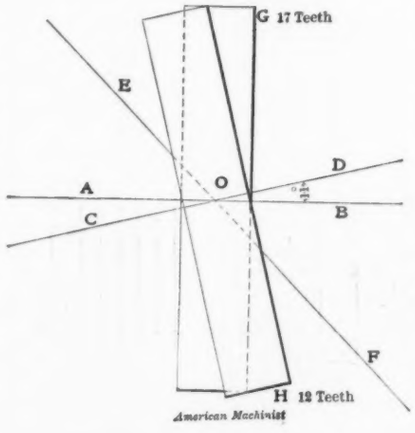
The gears are to be of almost the same pitch diameter, and as the shafts are 6.625 inches apart, the proper normal pitch will be found by the equation:

$$6.625 = \frac{17 \times NP}{\pi \cos.\ 55^\circ}$$

Transposing, we find:

$$NP = \frac{6.625 \times .5736 \times \pi}{17} = 6102$$

which is nearly 5 diametrical pitch; therefore we use a No. 5 pitch cutter. Subtracting this value for trial in the equation, we have:



A SPIRAL GEAR TRANSMISSION.

$$\frac{17 \times .628}{\pi \times .5736} = 13.25 - \frac{12 \times .628}{\pi \times .4067}$$

and the two sides reduce to:

$$5\ 93 = 7.35$$

which shows that we must find other angles and diameters for the correct solution if we are to use standard cutters. This work should be done with the slide rule. The AMERICAN MACHINIST had an article some four years ago on the slide rule, and I have never ceased to thank it mentally for urging me to invest in that well-nigh indispensable instrument. I used to dread, and often shirk, the correct solution of a problem because of the tiresomeness of the endless multiplying and dividing. The same problems are play when solved with the aid of the slide rule.

A few trials of new cosines show that we must increase the angle; and by picking out cosine values of angles 11 degrees apart, the angles 58¼ degrees and 69¼ degrees make the sides of the equation reduce to 6.455 = 13.25 — 6.77, or 6.48, which is near enough; and by making the 17-tooth gear 6.46, and the 12-tooth gear 6.77 inches pitch diameter, we secure a small amount of play between the teeth.

An examination of the figure shows that the two gears are running as spur gears, and that G is right hand and H is left hand.

These gears were examined with much curiosity and amusement by the workman who placed them on their shafts; and he never expected them to rotate, but they went together perfectly, ran from the first trial and never gave trouble.

This example of spiral gearing shows that gears run as true spirals, *i. e.*, are of the same hand angle, when the tooth angle divides the small angle between the shafts; and run as spur gears of opposite hand angles when the tooth angle divides the large angle between the shafts.

CLINTON ALVORD.

Cutter Grinding in Small-Arms Plants.

I note with great surprise what Mr. Stern says, at page 558, Part I, about grinding irregular gang cutters for rifle parts.

He says that the operator grinds the cutters to produce work to very narrow limits, and to do this "follows the contour by his eye and the sense of touch."

He conveys the general impression that such cutters, so ground, are superior to formed cutters, and quotes a "man from Springfield" as saying "that the results obtained with cutters ground after this fashion were superior to those obtained with formed cutters." He also invites comment from users of such cutters.

As a formed-cutter man I would like to take the other side. I am directly engaged in the manufacture of formed cutters, making from six to twelve a week, while it is often a three-days' job for a man to make the master-tool for such a cutter.

The accuracy with which these cutters are made would be surprising at the least, possibly amazing, to those not familiar with the work, intricate shapes being made to conform to gages, well within the limit of variation of .001 inch. Take with this the fact that the cutters are required when finished to run true within .002 inch radially and laterally, while the sides must be dead true, and it can be readily seen that the results must be very accurate and certain—known before the cutter is tried.

There is where the weakness of the free-hand-ground style of cutter is apparent—quoting Mr. Stern, "After a piece has been milled, if it is not accurate to gage, the cutter is again taken to the grinder." What guarantee have you that it will then be any better? How many times will he have to cut and try? By the time he has the offending cutter to shape is it not apt to be below size, so that all the other cutters of the gang must again be ground down to restore the rela-

tions? And might not this process be repeated indefinitely?

On the other hand, a gang of formed cutters can be ground at one trial, without question, to proper relations, by rotary-grinding some spot of known size on each until all the teeth are touched, and then radially grinding out the marks so made; while, as a test of accuracy, a symmetrical piece milled with a formed cutter can be halved, and its parts found to fit interchangeably.

Another point that seems to have escaped Mr. Stern's notice, is the extreme difficulty, almost amounting to impossibility, of getting small intricate shapes and sharp angles accurate—or getting them at all—while in the formed cutter any shape that is not undercut can be produced.

I might also say that we are, and long have been, shipping, without trial (but after careful inspection), to various parts in this and other countries for immediate use by critical customers, and have yet to receive our first complaint of the inaccuracy of a cutter. HERBERT V. PURMAN.

Collodion for Restoring the Surface of Tracing Cloth.

I have recently been doing considerable erasing on tracing cloth, and it is noticeable that after the ink has been scratched off of the cloth a very poor surface is left to re-trace on, especially if the lines are heavy. In considering whether there might not be some substance which would restore the surface, I happened to think of collodion. To apply this the place around the erasure must be perfectly clean, and it is best to apply with a small camel-hair brush, then let it dry. This is important, for if not properly dry it will make a large blot. I have used it considerably lately, covering large spaces with it and re-tracing with heavy lines quite satisfactorily. After using the collodion be sure and cork it up well or it will dry up. PAUL W. RIEDEL.

Cutting Oil Grooves in Boxes.

Having hundreds of boxes, of from 1¼ to 1⅝ inch bore, and from 8 to 10 inches long, in which oil grooves had to be made, I determined to devise some means by which they could be cut better and at a much less cost than by the chipping and filing method we had previously followed. So the fixture shown in the photographs was constructed, and when this fixture is in place for holding the box and the table, length of stroke (so as to leave the ends blind) and the stop for depth of groove adjusted, it is not necessary to even look inside of the box when cutting the groove; the operator has simply to place the box in the holder, tighten the screw by hand, feed up against the stop, and feed down again until the stop is open about 1-16 inch more than the depth of the groove.

Fig. 1 shows fixture *A* in place. It has a tongue in the center of the bottom, parallel with the hole for the bushing, so that it can be put in place instantly, and is held by two bolts on the Henley shaper knee. Split bushing *B* is held in place by headless screw *C*, so as not to pull out when the box is being removed. This bushing is used for convenience in clamping to avoid marring the box with a set-screw; also, different bushings may be used for different size boxes. Box *D* is 3⅛-inch diameter where held in the bushing. Nurled knob *E* does the clamping. Tool holder *F* is inserted in the apron in the same manner as the regular tool post, and is held firmly in place by nut *G*, which fits the thread on the bar. Cutter *H*, which is of ¼-inch square steel, is held by means of a set-screw in the end of the holder and with the cutting end, which is ground to the form of the oil groove, pointing upward, thereby preventing it from riding over the work rather than cutting, as it would do with the long holder were the tool put in to cut at the bottom. The spring of the holder is sufficient to prevent injury to the cutter by dragging on the return. Another advantage of cutting on the upper side of the box is that the chips drop out of the way. Stop *J* is held in place by set-screw *K*, and is so adjusted that when the vertical slide of the head comes up against it the oil groove is to proper depth. Box *D* is a polisher spindle bearing, 10 inches long, with 1¼ inch bore.

Fig. 2 shows the box held in the fixture, ready for cutting the groove. The old way, by actual test on a box 10 inches long, took 13½ minutes to chip and file the groove, while only 1⅓ minutes were required to cut one in the shaper with this device and a much better job was done.

J. A. SKERRY.

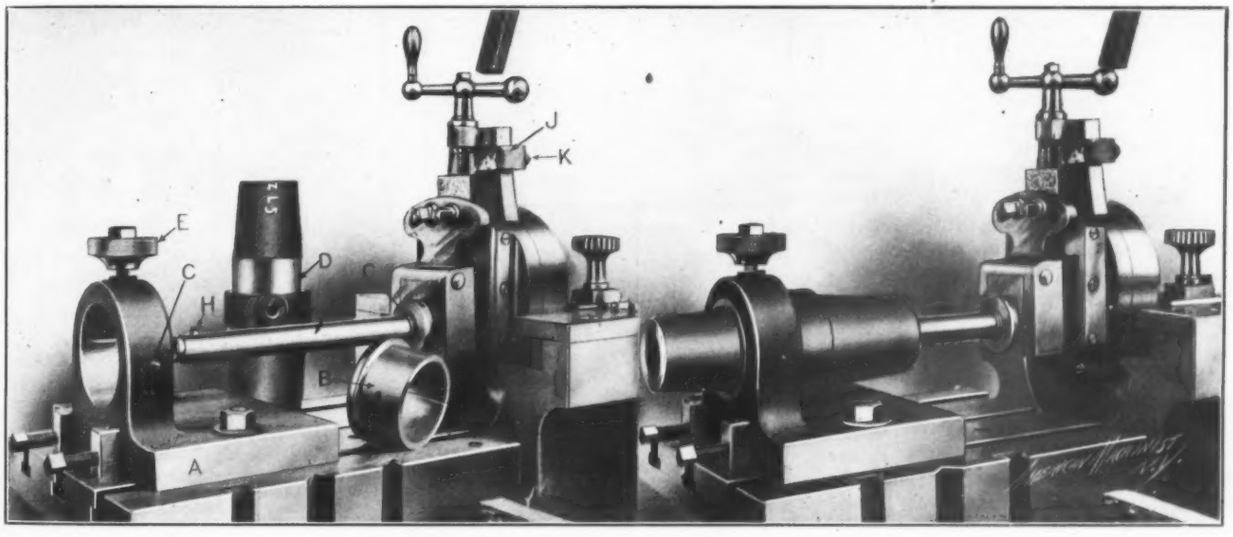


FIG. 1. SHAPER ARRANGED FOR CUTTING OIL GROOVES IN BOXES. FIG. 2.

The Blueprint Process as an Adjunct to the Typewriter.

It very often happens that a number of copies are wanted of a specification, notice or some other paper, a mimeograph or hectograph is not at hand, too many copies are desired to permit of manifolding, and it is not desirable to go to the expense of printing. In such a case the matter can be written out by a typewriter, a piece of carbon paper being put in back of the sheet, so that the printing is given density by being on both sides of the paper. This sheet is then used to make blueprints from in the usual manner. Thin manifolding paper should be used; the grade called unglazed onion skin gives the best results. After prints have been made the sheets can be filed for future use, if desired. If white prints are wanted, new carbon paper can be used and the prints made from that, the letters in this case appearing on a white ground, and while this has a handsome appearance, carbon paper is not as cheap as white paper. A. D. WILLIAMS, JR.

[The process described in the foregoing is no doubt quite familiar to many of our readers, but as it may not have come to

the attention of others, we publish it. Mr. Williams enclosed a sample blueprint from a type-written sheet, which print is quite clear and legible.—Ed.]

Is This Success?

If Mr. Pearce really wants to know whether the young man he refers to under the above caption at page 229, Part 2, Vol. 28, was a success or not, he will have to tell us whether his life was insured for enough to carry his family through. Of course, under the present administration, we would not dare to consider him a success unless he had a family. But, to be serious, there are a lot of mistaken notions abroad as to the relation between hard work and long hours and success. By success I mean, for the present, material success. I know two men, each about sixty years of age, who started in the same shop together. The first of the two was a good mechanic and a hard worker. Today he draws his $2.50 each day and never would get any higher no matter what happened. The other was lazy, incompetent, and suspected of being "not all there." A few days ago he sold out his business and retired with enough so that he can keep his stable of fine horses for the rest of his life. Another instance: There were two chums who were in my class in school. One graduated at the head of his class and it has taken the aid of a rich uncle to keep his head above water. The other just scraped through with the aid of some elaborate cribs. Now he is in business for himself in engineering work in New York and rides in his own automobile. Such things are happening every day, and they make the old fable of the hare and the tortoise look black in the face. There must be something that the midnight toilers overlook. What is it? This is my guess: They forget to study themselves, their neighbors and the world. They dig away at logarithms and steam tables and temperature-entropy diagrams in blissful ignorance that their position in the world is one related to other men and dependent on other men; that after fitting themselves to hold a position it must be wrenched away from a hundred other men equally well fitted to fill it; and that once held, it is only a challenge to other men to take it away. His success depends on the way he can handle every one, subordinates and employers, men of influence, and men who imagine they have influence. I believe that our young men in the shops are apt to confine their acquaintances to their own kind, to their great disadvantage. No man can make a successful foreman or superintendent unless he has either a natural or an acquired knowledge of human nature, and even the natural kind grows rusty if not exercised. Some knowledge of your trade or profession is really necessary, and the more you have the better, if you don't let it so obscure your vision that you can see nothing else. But if you are not away up in your work, a knowledge of men will enable you to pick assistants whose efforts may make you a success.

But if you make a material success, is it worth while? How many times will it happen that you have all the happiness that people think your money brings you? What if you can't sleep nights? What if you are in constant fear that some brighter man may mulct you of everything in a day and leave you where you started? What of the numberless nerve-wearing, soul-destroying things that rich men see? Very few with whom I am acquainted will own, in confidence, to freedom from compensations for their wealth. What success is there, then, that is rewarded or that is worth while? Is it the success of the man who leaves much money and lands to his children? Or is it the success of the man who makes two blades of grass grow where one grew before? Or the success of the man who leaves some little corner of the world wiser, happier, saner, than it was before? I believe that last. Man is thrust into this world without his own permission and amid surroundings not of his choosing. For a man to rise up and hammer out for himself a pathway entitles him to some credit, but if he would have the word success written against his name he must leave behind him a broad path over which other men may safely pass to start their battle deeper into the world. And to the mechanic and the engineer, more than even to men of the cloth, is given in larger measure the opportunity to make this fight, for upon them devolves the necessity of ruling material and nature and men, one as much as the other, so that succeeding generations may, not necessarily be lazier, but that they may have more time to devote to those amenities of life which make it worth living.

Entropy.

An Assembling Jig.

In the accompanying sketches is shown a jig for drilling several unlike parts simultaneously to facilitate assembling. The kernel of the idea is that it overcomes the difficulty that would be met if it were attempted to drill semicircular holes in the circular edges of a number of separate, unlike pieces, and also save fitting on the assembling bench.

The jig is shown complete in Fig. 1. In Fig. 2 are shown, respectively, a hub *a*, a gear *b* and a one-tooth transfer gear *c*, which are to be assembled as indicated, the single tooth of *c* to be so placed in relation to any tooth of *b* that its right-hand flank will coincide with the right-hand flank of its companion tooth in *b*, as shown at *d*. The parts of the jig are so arranged that *a b c* are held in their proper relations while two holes are drilled through the flange and edge of the body of hub *a* and the edges of the holes of gears *b* and *c*, when they are removed and placed on racks until the time when they are to be riveted.

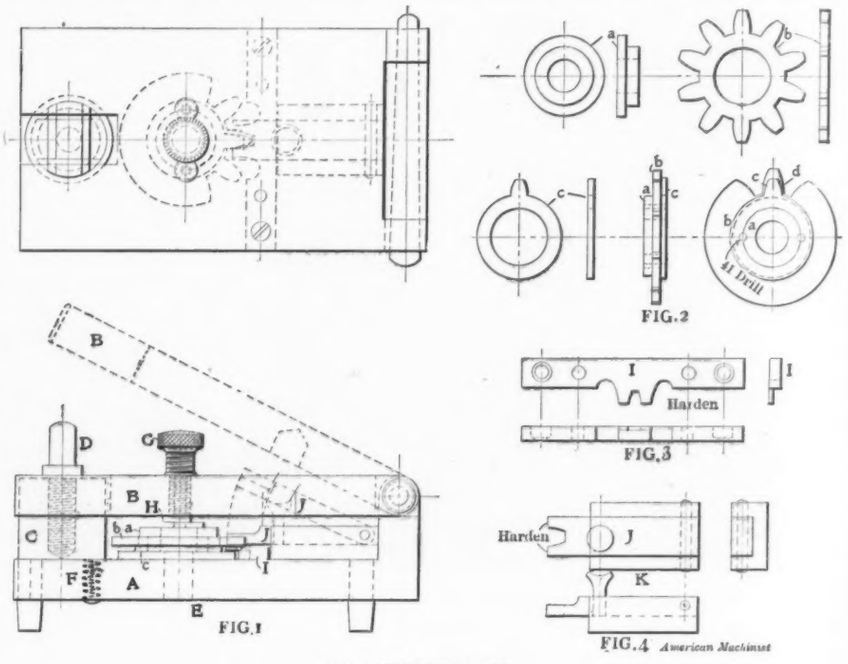


FIG. 1 FIG. 2 FIG. 3 FIG. 4 American Machinist

AN ASSEMBLING JIG.

The jig is of the usual box or lid type. *A* is the bottom plate, having the usual feet and carrying the taper pin on which the lid *B* hinges. *C* is a stud driven into the base and further secured by a headless screw and flatted to fit the slot, and *D* is a winged thumbnut to hold the lid in position.

Into base *A* is driven a stud *E*, upon which the work *a b c* is centered, *F* being a hardened circular base plate held to the base by screws not shown. *G* is a thumbscrew screwing freely through lid *B* and having fixed at its lower end a round

swiveling plate *H* for holding the work in place. The two drill bushings are located as shown.

I, shown in detail in Fig. 3, is a steel piece of rectangular cross-section screwed and doweled to base *A* and having two hardened projections whose inner faces conform nearly to the shape of the single tooth of *c*, and is used for locating *c*, while *J*, shown in detail at Fig. 4, does the same for a tooth of *b;* upon the relative positions of *I* and *K* depends the accuracy of the jig.

In operation, while the lid is raised, the gears *b* and *c* are first placed upon the hub *a*, and all are slipped over stud *E*, the pivoted locating lever being held up out of the way, *c* revolved until its single tooth drops between the projections of *I*, and *J* dropped to locate one of the teeth of *b;* then the lid is closed and clamped by its thumb-screw and the work clamped by thumb-screw *G* and its plate *H*, when all are drilled together.

While I personally believe the design could be much improved upon, especially in providing compensating features for the unavoidable, slight variations in the thickness of the gear teeth, that is a matter of personal opinion, and the jig was built "according to orders."

A. B. CHRISTMAN.

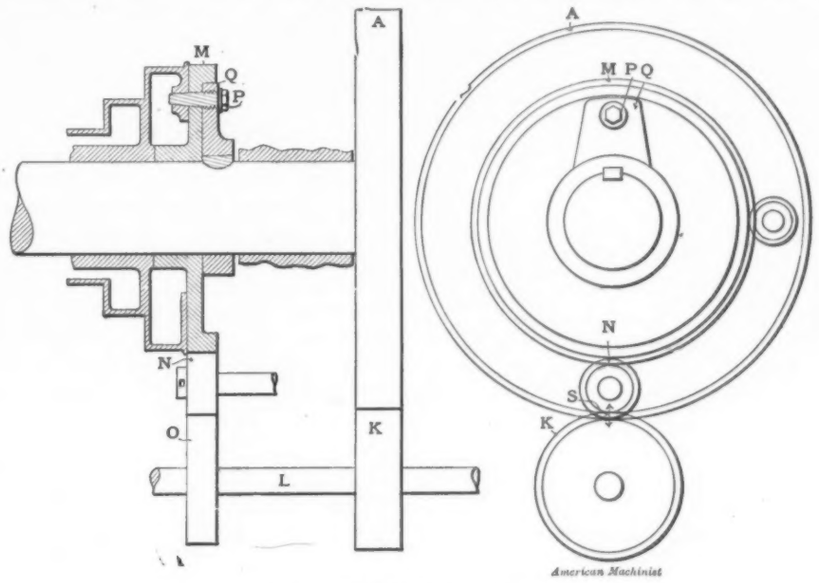


FIG. 3. DETAIL OF THE DRIVE.

Improved Crankshaft Lathe.

I enclose a few details of the W. de Sanno crankshaft lathe. It is not necessary to go into details in regard to the present way of doing this class of work, as we all know that the centers must be screwed up tight enough to support the work and resist the cut of the tool; and this cannot be done without springing the work. I propose to drive the work from both ends simultaneously, also to support each end in a chuck, as shown in Fig. 1.

What I call the "chuck gear *A*" is a combination gear with graduated chucking device. This chuck gear goes on the spindle in place of the face-plate. On the face of the gear are the ribs *b* (see Figs. 1 and 2); on the side of one of these ribs is the graduation in inches and fractions, the center of the lathe being zero. Moving in these ribs or ways is the sliding chuck-holder *C*, having a zero mark at its center and being actuated by the screw *D*. The sliding chuck-holder should be bored out in place to receive the chuck *E;* the beveled edge of this chuck *E* is graduated in degrees, having a zero mark to correspond with the zero on the chuck-holder.

In Fig. 2 is shown plan of the chuck and hold r removed from the gear *A*. In the flange part of the chuck are shown the carved slots *F;* in the plan of the holder is shown a series of tapped holes. The chuck is held in place in the holder by the tap bolts *G*, Fig. 1. There are two of these bolts in each curved slot. By taking these bolts out and turning the chuck into the position wanted, we can always get two or more holes where we can use them.

Fig. 1 shows a crankshaft in the lathe. There are no ordinary centers in the chuck to take the end of the shaft, as they cut no figure in the job. We first rough out the work in the usual way, and then turn the ends to a given size (not the finished size); fit a cast-iron bushing to the end, and fit the bushing ring to the inside of the chuck (make good fits). The set-screws *H H* are tapped through the chuck and must be tapped through the bushing with a continuous thread. These set-screws go in and pinch the end off the shaft (the set-screws should be cupped). By making a continuous thread through the chuck and the bushing ring, we do not distort the chuck when setting up the screws. All bushings called for in the different sizes of work must be put in on these lines. The danger from using an ordinary center instead of a cupped center is, that in setting up the screws, the possibility of forcing the work off the center. We also have the fear of end thrust to contend with, which is to be avoided.

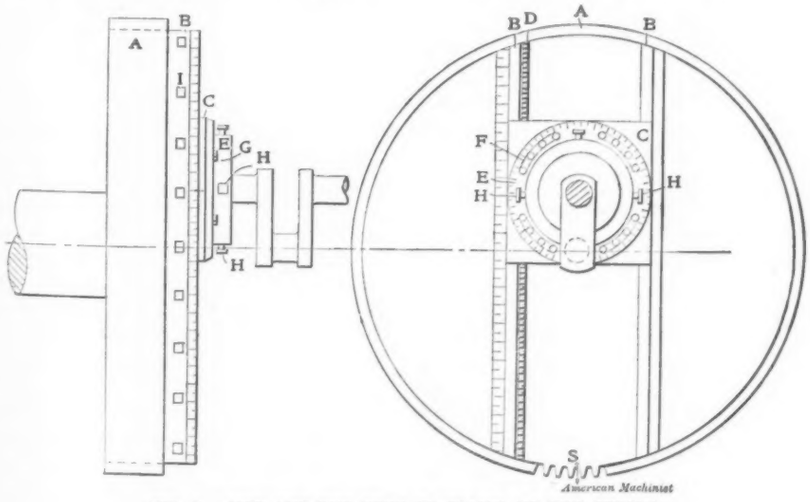


FIG. 1. SIDE AND END VIEW OF CRANK IN THE CHUCK.

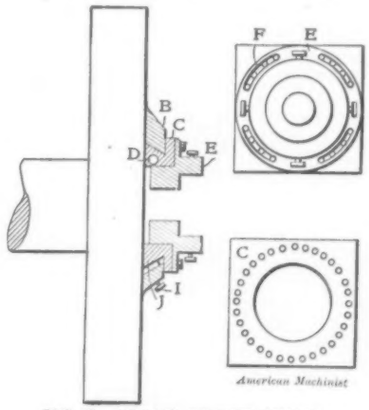


FIG. 2. DETAIL OF THE CHUCK.

We will supppose the crank is for a 4-inch throw, with the chuck at zero. We put the end in the chuck, with the crankpin in proper position, set up the set-screws *H H*, also the bolts *G*, loosen the set-screws *I*, which bear on the gib *J*, Fig. 2, and move the whole business out two inches from the center (zero) by the screw *D;* then set up the gib screws. The

crankpin is now ready for turning. Running in suitable bearings in the tailstock, is a similar chuck gear, which carries the opposite end of the shaft. These two chuck gears are driven by an auxiliary shaft, running in line with and between the shears; the location of this shaft is not arbitrary.

In Fig. 3 is shown the arrangement of the gears. *A A*, the two chuck gears, are connected through the gears *K* and auxiliary shaft *L*. *M* is the large gear in front of the cone; this gear has generous bearings, as it runs loose on the spindle. When using back gears the cone runs backward, there being open and cross belts overhead. The large gear *M* transmits motion to the two chuck gears through the gears *N O* and shaft *L*, Fig. 3. To run open speed throw out the back gears, move the gear *N* back on the stud, screw in the taper lock bolt through the piece *Q*, which is keyed to the spindle, and through the gear *M* and the cone, as shown. In this change the chuck gear drives its mate through the gear *K* and the shaft *L*. The auxiliary shaft *L* has a keyway nearly its whole length to allow the gear *K* on the tailstock end to move back and forth to suit different lengths of work. This shaft runs in a hanger under the tailstock. When the crankpin shown is finished, take out the bolts *G* in both chucks and turn the whole thing around to 90 degrees if that is what is wanted, or to 120 degrees for triple throw. Do not move the chuck-holder or loosen the set-screws on the shaft until the job is finished.

When eccentrics are forged on the shaft, proceed the same as for cranks, except to set the chuck the number of degrees forward or back of the crank that the drawings call for. The chuck-holder being bored in place, insures it running true. The chuck gear *A* should not be removed from the spindle unless there is a certainty of it going back to the same place. The double arrow mark *S*, Figs. 1 and 3, is to be on both the chuck gears and the gears *K* to preserve alignment. These drawings are not to any scale or proportion. In turning up old crankshafts and eccentrics, this system will be found all right; and if it is not so, let someone point out where it is wrong. The tailstock is moved up to the work with the pinions and rack in general use. The details of the tailstock and features for straight work are not shown.

W. DE SANNO.

Fruitvale, Cal.

A Tube Expander.

The sketches herewith show a style of self-feeding roller expander that has some very good points and ought to be of interest to those making and using expanders, and particularly those who are using heavy tubing for smoke flues, etc., for which this tool is especially adapted.

The expander consists, as in Fig. 1, of a body *A*, rollers *B*, roller retainer *C*, collar *D* and its set-screw; all of which may be made of tool steel, hardened and drawn to the temper required by each part. *A* is made first, the bore being enlarged at the roller end to admit the retainer *C*, which is simply a thin shell made to fit snugly in place. A small screw is now let in through body and retainer to prevent the latter moving during the milling operation, and also to hold it in place while the expander is in use. It will be noticed that the two parts, when assembled, have a straight hole of the same diameter through them, which allows the taper spindle *E* to enter full depth and still have a little clearance.

A and *C* are now taken to the milling machine, where the rear end of the body is gripped in the chuck on the dividing head with the other end on the dead center, holding the roller end down at an angle of 2 degrees (this is for right-hand revolution of spindle *E*), and an end milling cutter, whose diameter is, say, 1-16 inch smaller than that of the rollers, is worked through both body and retainer. This cutter, by the way, should be centered at a point on the axis of *C*, midway between the points determining the length and position of the rollers. This slot must also be 1-16 inch less in length than the rollers. After all three slots have been milled thus, another cutter is substituted for the end milling cutter. This new cutter is made of somewhat spherical form, and is about 1-100 inch larger in diameter than the first cutter; it has two opposite flats parallel with the axis, and the distance between flats is small enough to allow it to pass freely through the slots just milled. The retainer *C* is now removed and the spherical cutter entered through one of the milled slots—the flats on the cutter permitting this—and the machine is started and the slots finished to width and length by working the cuts back and forth until the spherical cutter, started from the inside of *A*, approaches the outer edge and leaves a projection or lip, best shown in the section *a a*. This portion acts as a retainer, preventing the rollers dropping out. After all three slots have been finished in *A*, retainer *C* may be returned to place and the slots finished as in the section *a a*, leaving a space for the rollers, which, once in place, cannot drop out either through *A* or *C*; and the rollers, when in their pockets, should allow the expander to enter freely into the tubing as well as allow the taper spindle to expand them outward rather more than enough to expand the tubing to its limit. *C* may now be taken out and the ends of the slots opened toward the inner end, as shown in the detail, it being necessary to have these slots running to the end in order that the retainer may be entered to place when the rollers are in the slots.

The rollers are made to the form shown in the detail, having ends so rounded off as to be slightly longer than semi-spherical, which allows them to revolve rather more freely than when the shape corresponds exactly to the end of

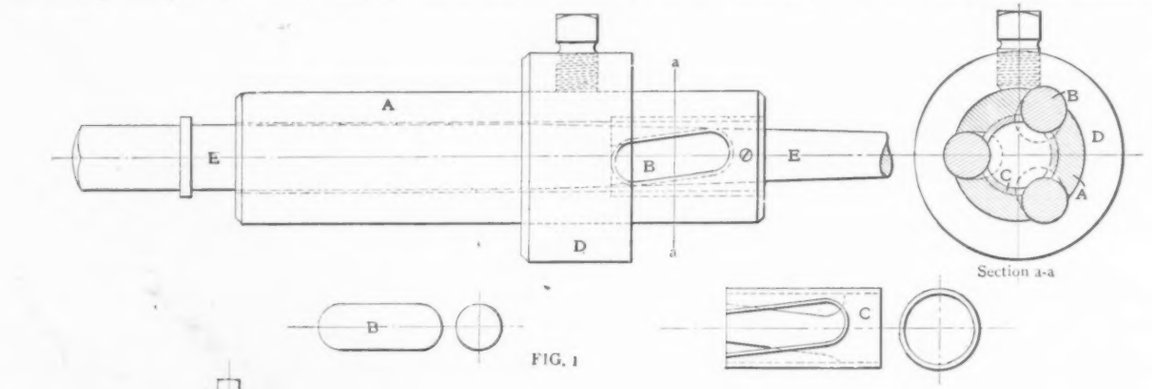


FIG. 1

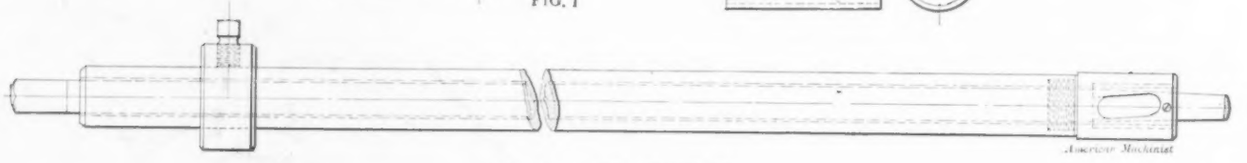


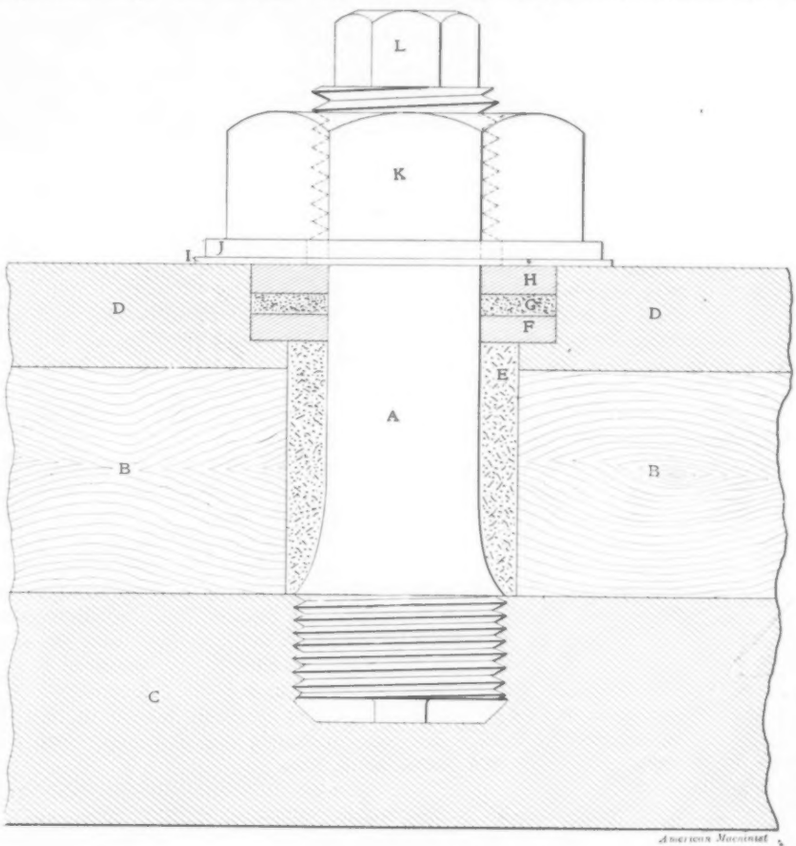
FIG. 2. A TUBE EXPANDER.

the slots. Collar *D* has three spots milled in the bore close to the face to allow the rollers to move outward into them, which is very necessary when rolling in tubes close to the end, which is oftenest the case. Spindle *E*, near the head, is made to enter the body *A* easily, and is tapered ⅜ or ½ inch per foot, the ⅜-inch taper per foot giving best results in heavy tubing.

In the expander selected for illustration and used in tubing 1¾ inches outside diameter, the body is 17-16 inches, and the rollers ½ inch diameter, and the spindle tapers from 7-16 inch diameter at the small end up to ¾ inch at the head. This proportion keeps the average working portion of the spindle a trifle larger than the rollers, which seems to be essential to the longevity of the spindle, which is more expensive to replace than the rollers.

As will be seen, the collar can be adjusted anywhere along the body for rolling inner heads, etc.; the rollers, having spherical ends, do not cut into the tubing, but swell it out gradually; the ends of the slots being curved and not extending to the end of the body, do not weaken that part appreciably; the rollers cannot fall out when the spindle is withdrawn; and, above all, the tool works quite easily, since the ends of the rollers form a kind of ball pivot. The expander can be made of any length, and the firebox ends of flues can be expanded from the outside if desired.

Fig. 2 shows a method of attaching to a long shank for work mentioned in the foregoing paragraph. X. P. ANDER.



ARMOR-PLATE BOLT.

Armor-Plate Bolts.

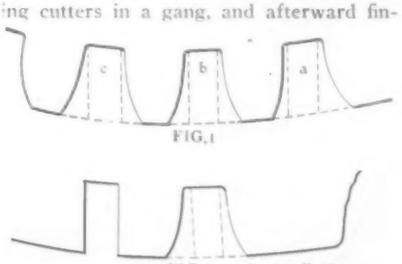
While the articles that appeared in the AMERICAN MACHINIST relative to the rapid production of "armor-plate" bolts were very interesting, I am curious to know how they are used and I think a number of us machinists living in this part of the country or away from the sea would be equally interested. Can't you show us a single cut or sectional view of the plate with bolt and nut? I think this would be appreciated. W. B. WARD.

Richmond, Ind.

[In response to this we present the illustration. The ship's "skin" or plating *D* is covered with a sheathing of wood *B*—generally teak. The wood forms a bed for the armor plate *C*. The armor-plate bolt *A* screws into the armor plate—the end of A having a hexagon *L* formed on it to fit a wrench. The body of the stud is reduced to the diameter at the bottom of the thread at the nut end. The object of this reduction is to make it elastic so that it will not be liable to snap under a sudden jar. A "gromet" or sleeve of oakum *E* surrounds the body of the bolt where it passes through the wooden sheathing and the ship's skin beyond the steel washer *F*. Between the steel washers *F* and *H* is the rubber washer *G*, the object being to make a water-tight joint where the bolt passes through the ship's skin—the position of these bolts often being below the water line. *I* is a canvas washer soaked in thick red-lead paint. *J* is a steel washer, and *K* the nut. The two steel washers *H* and *F* are made in halves, as otherwise it would be impossible to make them a snug fit for the reduced body of the bolt. Formerly armor-plate bolts were passed clear through the armor plate and had either tapered or fillister heads fitting suitable recesses in the outside of the armor plate. The illustration shows the latest United States Navy practice in this line. The diameter and length of these bolts depend upon the thickness of the armor and wooden sheathing, six inches diameter being not unusual.—Ed.]

Stocking Out and Finishing Large Gear Teeth.

In a number of shops large gears are stocked out by using two to four stocking cutters in a gang, and afterward finished by using a single cutter. Suppose the gear has been stocked by using three cutters in a gang. When finishing the space *a* in Fig. 1, the cutter starting into the gear cuts heaviest the right of this space and presses the gear to the right, and when starting into the next space, *b*, it cuts about central, and the side pressure is about equal to right and left; but on starting in at *c*, the pressure of the cutter tends to rotate the gear slightly to the left. The result is, two teeth are thinner than the proper size, and every third tooth is thick. Some firms claim they can get the best gear by finishing the gear at once out of the solid.



STOCKING OUT AND FINISHING LARGE GEAR TEETH.

The following method I never saw tried, except in the shop where I am now employed: Place the forming cutter central, slip on a collar and then the stocking cutter. The collar should be of the proper thickness to bring the stocking cutter into position to stock out ready for the next cut the finisher takes, as in Fig. 2. Next substitute for the forming cutter a collar of the same thickness as the cutter, and stock out at one place. Take off the collar that was substituted for the finishing cutter, and in its place put back the cutter as before. Now we have on the arbor

the finishing cutter starting into the stocked-out cut, and the stocking cutter to the left stocking out the next place for the finishing cutter. In this way the forming cutter always keeps the same amount of pressure on the gear while cutting, and the pressure is to the left. L. B. G.

Curling a Bicycle Tube Reinforcement.

Some years ago—when bicycles were at the height of their popularity—I invented the reinforcement shown in side, end and perspective views at Fig. 2. Fig. 1 is the blank.

The usual reinforcement was a cylindrical shell slipped inside the tube at the joint and brazed in position. The strains vary in direction at various parts of a bicycle, and the fin *X Y* was intended to be placed so as to withstand these strains.

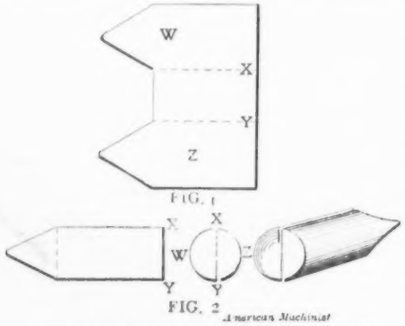


FIG. 1 FIG. 2 American Machinist

THE BLANK AND THE REINFORCEMENT.

The common reinforcements were used in enormous quantities, and I thought I had a fortune in sight. While the Patent Office was going ahead, I designed the machine shown at Fig. 3, for curling the blanks, which were made on an ordinary punch press.

The arbor *A* has a slot sawed through the front end. This slot is about .010 wider than the thickness of the blank, and reaches as far as *G* (see the side view, Fig. 3). *A* is a running fit in the end of the sleeve *B*, from *G* to *I*, but the front end of *B*, from *G* to *J*, is bored—twice the thickness of the metal used in the reinforcement—larger than *A*. Opposite the slot *C* is a receptacle *F* for the blanks. Underneath *F* is a wide slot *E* in which a reciprocating finger works, catching the bottom blank at *D* and pushing it into the slot *C*. The reciprocating finger—not shown—is actuated by the foot-lever, which trips the clutch and starts the machine. The shaft *A* has at its back end a long spline *P*. *A* works in two bearings *K*. Between these bearings are a collar *L*—splined to the shaft *A*—and a flywheel *M*, the two bearings *K* keeping the collar and flywheel in position while the shaft is reciprocated through them. In the collar *L* is the usual clutch used on punch presses, the hub of the flywheel being toothed on the side for the clutch pin to drop into. Beyond the back bearing *K* is a grooved collar *N*, set-screwed to the spindle *A* and provided with a yoke *O*. The yoke *O* throws the spindle *A* forward—a distance a little greater than the length of the reinforcement—and then back to its normal position—as shown in Fig. 3—during one half of the rotation of the shaft. The movement of the yoke *O* is obtained from a cam on the collar *L* and multiplying levers.

The action of the machine is this: The magazine *F* is filled. The operator depresses the foot-lever. During the first part of the travel of the foot-lever it causes the feeding finger which works in *E*, Fig. 3, to push a blank into the slot *C* till the far edge of the blank strikes a stop at *R*. Further movement of the foot-lever trips the clutch in the collar *L*, and *A* begins to rotate, curling the two sides *W* and *Z* of the blank, Fig. 1. By the time *A* has made half a turn the curling is practically finished. The cam on the collar *L* then comes in contact with a lever which actuates the yoke *O*, pushing the spindle *A* forward and with it the curled reinforcement until the reinforcement is past the face J. The reinforcement then springs open slightly, and as the arbor *A* moves back to its normal position it is stripped off the end of *A* and falls into a receptacle. By making the feed dependent on the trip for the clutch, errors in hand feeding were avoided, and the operator—a boy—had both hands at liberty.

If by chance the operator forgot to lift his foot off the lever and a second revolution of the machine took place, no blank was fed. The operator was guided by sound. As soon as he heard the finished piece fall into the box, it was time for another stroke of the foot-lever.

People often kick about the slowness of the Patent Office, but it is rapid in comparison to the snail-like pace of Fortune. The patent was allowed eight years ago; the fortune has not arrived yet.

DIXIE.

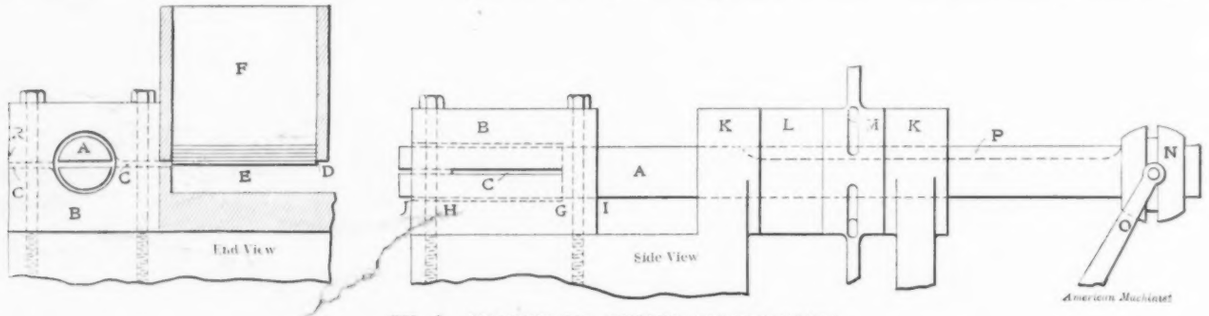
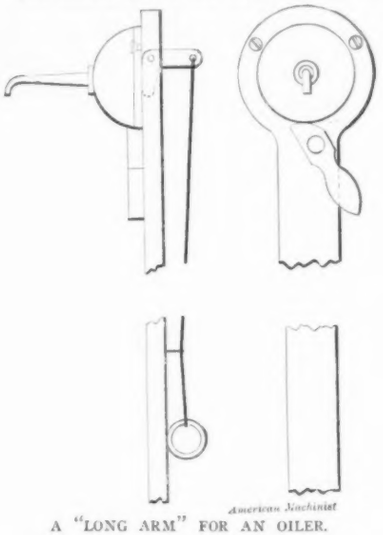


FIG. 3. MACHINE FOR CURLING REINFORCEMENTS.

A "Long Arm" for an Oiler.

The accompanying sketch shows a simple device which I first saw used by one of our oilers to save much of the muscular energy usually expended in climbing the ladder to bring him near enough to countershafts, jackshaft and lineshaft for the purpose of oiling them.

The sketch shows the device to be simple and easily made. It consist of a piece of ¾-inch hardwood or ⅞-inch pine board cut out to about the shape shown and means provided by which the oil-can is gripped or released; and the little lever, at the back of the oil-can, with the wire connection with the ring placed at a convenient position on the handle for the purpose of pressing the bottom of the oil-can—supposing that a spring bottom oil-can is being used.



A "LONG ARM" FOR AN OILER.

The device enables the oiler to greatly reduce the time usually necessary for oiling and is much less fatiguing, since he is required to climb only for loose pulleys and similar places.

Perhaps the oiler in every machine shop may not see this, but the device is a good one and someone will pass it on to him.

W. M. Fox.

Raising Decimals to Fractional Powers.

At page 226 is an article on this subject which gives the fundamental method of performing such operations. However, considerable experience leads me to prefer the following method:

Find the reciprocal of the given decimal from a table of reciprocals. Raise this number to the desired power by multiplying its logarithm by the exponent, and find the corresponding number. Then find the reciprocal of this later number from a table of reciprocals, giving the desired answer. Using, as a sample, the case given at page 226, let it be required to evaluate $.3047^{\frac{1}{3}}$.

We have 1/.3047 from a table of reciprocals = 3.2819; log. 3.2819 = .516123; .516123/3 = .17204. Antilog .17204 = 1.486. 1/1.486 = .6729, which is the desired answer. Of course this method is applicable only when the computor has a table of reciprocals, such as Barlow's tables, readily at hand. The average man can handle the method given above more readily than the more scientific method given at page 226. SANFORD A. MOSS.

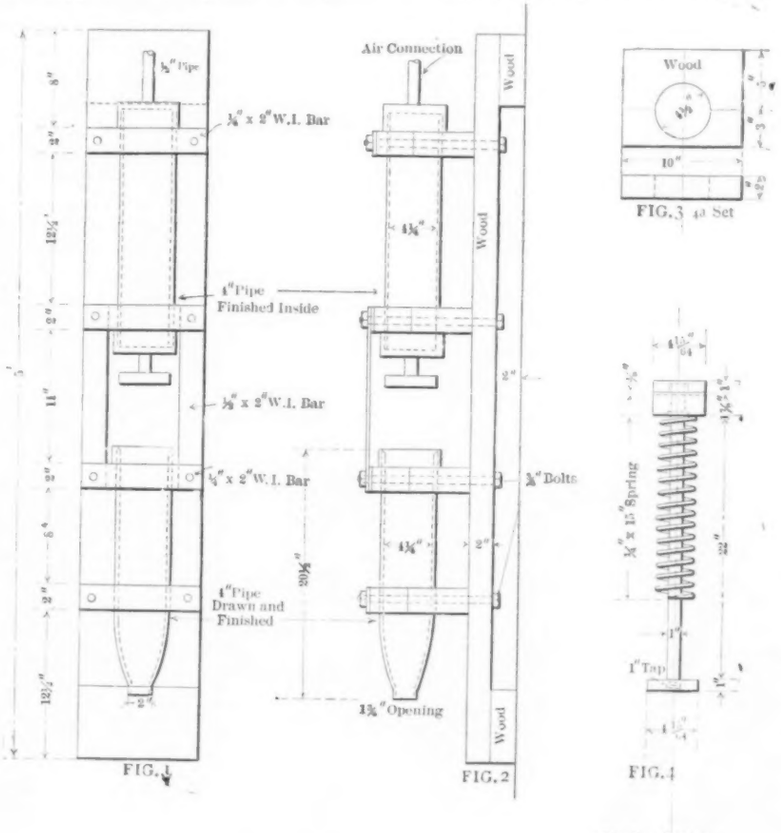
Dope-Candle Former.

The sketch shown herewith illustrates a new and decidedly up-to-date machine for forming dope-candles. Figs. 1 and 2 show the front and side views of the machine, Fig. 3 one of the wooden blocks which support the air cylinder and grease receptacle, while Fig. 4 shows the piston and plunger removed from the cylinder.

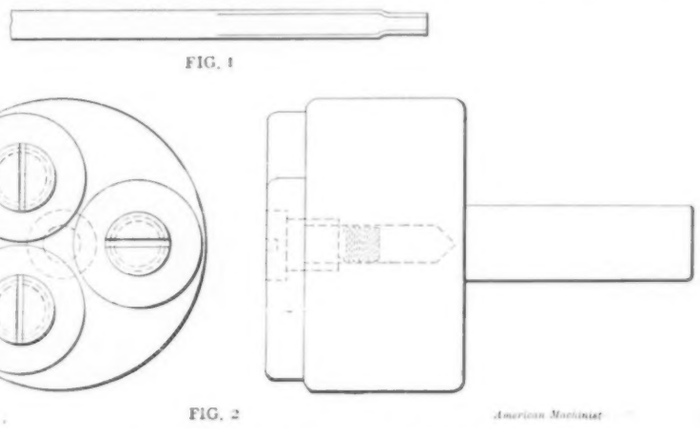
The air cylinder is a 4-inch pipe finished on the inside to 4¼ inches, and with a pipe cap fitted to each end, one cap being drilled out to allow the passage of the piston rod, while the other is tapped out to receive a ½-inch air pipe. The piston is cupped out to receive a leather gasket, thus preventing a leakage of air around the piston. The plunger is a disk 1 inch thick and made to fit loosely in the grease receptacle. It is held in the position shown in Fig. 1 by means of a steel spring 15 inches long.

To operate, the receptacle is filled with the dope or grease, and air being turned on forces the plunger down on the dope, pressing it through the opening at the bottom of the receptacle. It is then cut into lengths of one foot each and stored in tin boxes until ready for use.

G. E. B.



DOPE-CANDLE FORMER.



TOOL FOR ROLLING DOWN END OF STOCK.

Dope-Candle Former.

The sketch shown herewith illustrates a new and decidedly up-to-date machine for forming dope-candles. Figs. 1 and 2 show the front and side views of the machine, Fig. 3 one of the wooden blocks which support the air cylinder and grease receptacle, while Fig. 4 shows the piston and plunger removed from the cylinder.

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G. E. B.

A Tapping Kink.

We were using a large number of ¼-inch rods, Fig. 1, in one end of which there was required to be an 8-32-inch hole, tapped as deep as the length of the thread on the tap, which resulted in so many broken taps that we finally hit upon the idea of drilling into the rod a slightly larger hole than the body size of the screw to the depth required, and then rolling the end of the row for about ¼ inch in length until the hole was the tapping size, which made the work of the tap much easier, and the reduction of the outside diameter of the rod did not interfere with its usefulness.

Fig. 2 shows the tool made to be used in a screw machine. As it is fed onto the end of the work, the outer corners of the rolls are first rounded and then slightly tapered up to the full size of roll. The round and taper portions are nurled with a fine, straight-tooth nurl, and in practice the tool is started onto the work with sufficient force to make an impression of the small teeth on the work which keep the rolls revolving.

We first tried it without the nurling, but the friction of the small rod was not enough, any one of the rolls being liable to stop at any time. ROLLING.

A Fish-Line Belt.

A reader who is constructing a number of machines in which he is using a small fish-line for a belt, is having a good deal of trouble with this fish-line belt, and asks if our readers can give him any information about it which will help him to make it better suited to the purpose, or can suggest a substitute which will give better service. Possibly there is a way of lubricating the fibers of the fish-line so that it will give better service. Do our readers know anything of this?

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Contents.

	PAGE
The Use of Fuel Oil on the Pacific Coast	377
Industrial Use of Alcohol in Germany	379
Manufacturers in Japan and the Selling of Improved Machine Tools There	382
A Method of Making a Templet for Worm-Gear Tooth Patterns	384
A Novel Time Card	388
Selecting a Molding Machine—Molding a Cone Pulley	388
Machine Molding—IV	391
Competitive Test of Water Meters	394
A Universal Radial Drilling Machine	394
Employment of Children in Germany	394
Letters to the Editor: The Accident on the S. S. "Athos"....A Spiral-Gear Transmission....Cutter Grinding in Small-Arms Plants. ....Collodion for Restoring the Surface of Tracing Cloth....Cutting Oil Grooves in Boxes.... Is This Success?....An Assembly Jig	395-403
A Fish-Line Belt	403
Removal of Russian Discriminating Duties	404
A Government Contract	404
New Tools and Machine Shop Appliances	405
Difficult Molding Machine Work	406
Personal	409
Obituary	409

Removal of Russian Discriminating Duties.

Whether or not the removal of the discriminating duties against us by the Government of Russia is due to the fact that peace was brought about by the initiative of our young President, as some allege, it is a fact that efforts have been made for some time to secure the abrogation of these discriminating rates, and the fact that they have now been removed will be especially welcomed by builders of machinery who have had trade with Russia. It is bad enough when a manufacturer of machinery, in his efforts to enlarge his trade, encounters a very high hostile tariff; but when, as has been the case with American machinery manufacturers, they encounter a tariff which is very much higher than that which is imposed upon the machinery of any other country, the case is then much worse, and, in fact, brings about the practical ruin of the business. This is the condition which our American manufacturers have had to meet for several years, so far as Russian business was concerned. German and English builders have not only had the benefit of lower transportation charges and less expense by reason of propinquity, but they have enjoyed a much lower rate of duty upon their machinery; so much lower as to handicap the American builder to such an extent that our Russian machinery trade has been practically destroyed.

Of course, Russian users of machinery and of things made by machinery have been the chief sufferers from this; for competition in the supplying of machinery for the use of Russian people has been restricted. This injury to the Russian people by the deprivation of machinery and its products which they were in need of undoubtedly has, however, been so diffused as to be less noticeable than the injury which has resulted to a definite interest, such as that of the American machinery builders.

It is stated that Switzerland is to take similar action, as a result of which our machinery will enter that country upon as favorable terms as does the machinery of any other country. We hope this is true, and, in fact, we hope it will be true of every country, for there is no good reason why American machinery should not enter every foreign market upon as favorable terms as the machinery of any other nation. Our machinery and the methods of manufacture that go with it can be of great benefit to the Russian people, and we shall hope there will in the future be nothing to stand in the way of their receiving this benefit, which naturally will reciprocally benefit our machinery interests.

In connection with this the fact should be noted that at the present writing there is in New York city an exhibition of Russian art work and handicraft of various kinds, which work is pronounced by experts to be exceedingly meritorious and which is said to be the "entering wedge" for a business in such things here. We hope this is true. The more real art work is imported into this country the better. We have been as deficient in such work, and are still about as deficient in it, as are any of the European nations in manufacturing and mechanical matters. We shall do well to exchange our machinery for Russia's artistic goods.

A Government Contract.

One of the things to be learned from the trouble that has been going on in the office of the Public Printer at Washington, is that a manufacturer of machinery must be a little careful in writing letters, as to what charges he makes against a competitor who has secured an order which the writer of the letter desired to secure for himself. The Lanston Monotype Company has secured, from the Public Printer, a contract for seventy typesetting machines; the contract amounting to a considerable sum of money. It seems that the Linotype Company wished to secure the order, and upon failing to do so, its president, P. E. Dodge, wrote a letter to President Roosevelt, in which he charged that the Lanston company had obtained the contract by corrupt means; as a result of which Mr. Dodge finds himself sharply rebuked by the President, and with a lawsuit on his hands, brought by the Lanston company; the committee of investigation appointed to go through the matter, having reported that there was no evidence whatever of any corrupt doings on the part of the Lanston company. The committee did report, however, that men holding prominent and responsible positions in the Department of Public Printing, and who were in a position to influence, and did influence, the choice of machines, had wives who held stock in the Lanston company. While this fact is of course not sufficient to justify a charge of corruption, there are very few who would consider that under the circumstances competition for an order could be entirely fair and even.

It is always possible that a man holding such a position as may enable him to know that an important order is going to a certain company may advise his wife to acquire stock in that company, he himself being debarred from doing so by law. If the wife buys the stock, the subsequent placing of the order with the company comes very far from proving that an officer of the company has been guilty of corrupt practices. Among the net results of the matter is that the Lanston company has a large and presumably valuable contract, but we are sorry to see two prominent machinery-building establishments involved in a case of this kind.

New Tools and Machine Shop Appliances.

NEW MOLDING MACHINE.

The accompanying engravings illustrate a molding machine in which the motion of drawing the pattern is accomplished by fluid pressure in cylinders having a special feature to protect the packing from direct contact of oil under pressure. The machine also permits of being used upside down and drawing the pattern from the mold after it has been rolled over.

In Fig. 1 the central circular portion is the pattern plate, which is stationary and upon which the patterns are fixed; the frame surrounding it carries the flask and is caused to rise and fall by four plungers working in the stationary cylinders at the corners, so that, when the machine is right side up, the drawing of the patterns is accomplished by lifting the frame, flask and mold up off the patterns.

When the drawing is done from a drag flask with the machine in an inverted position, the pattern is lifted off the mold, not by the application of pressure in the cylinders, but by the use of the hoist from which the machine is suspended, the machine for this purpose being provided with trunnions (not shown in the one illustrated) which allow it to be rolled over while suspended from the hoist. In the action of drawing the pattern by hoisting the machine, the plungers serve simply as guides to maintain the steadiness and parallelism of the motion. When free from the mold, the machine is rolled back again into its normal position, the plungers returned to the bottoms of the cylinders and the machine is then ready for another mold.

The question of the effect on machines of all kinds of an inversion of their position is one which is not frequently considered, but which brings up a number of interesting points. For instance, one may consider a link having pins at each end, the centers of which must be kept at a constant and exact distance apart. If we take up the wear of the pins and their holes by shortening the link, we will find that upon the inversion of the machine, resulting in the force of gravity acting the opposite way, the error in the distance between pin centers due to the wear, has now been doubled, because the change in the length of the link produced by the correction is now added to the amount of wear, instead of neutralizing it. In a machine of the type illustrated, however, the moving frame being directly and rigidly attached to the moving plungers, there is no chance for such an inaccuracy to occur.

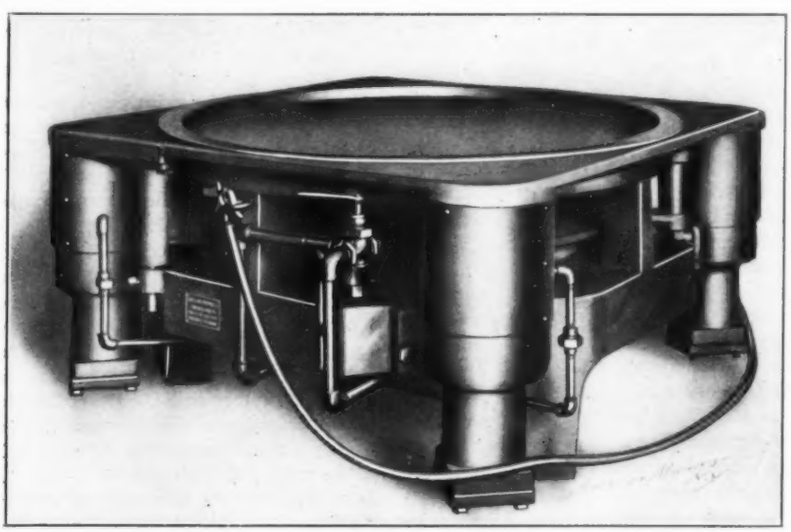


FIG. 1. NEW MOLDING MACHINE.

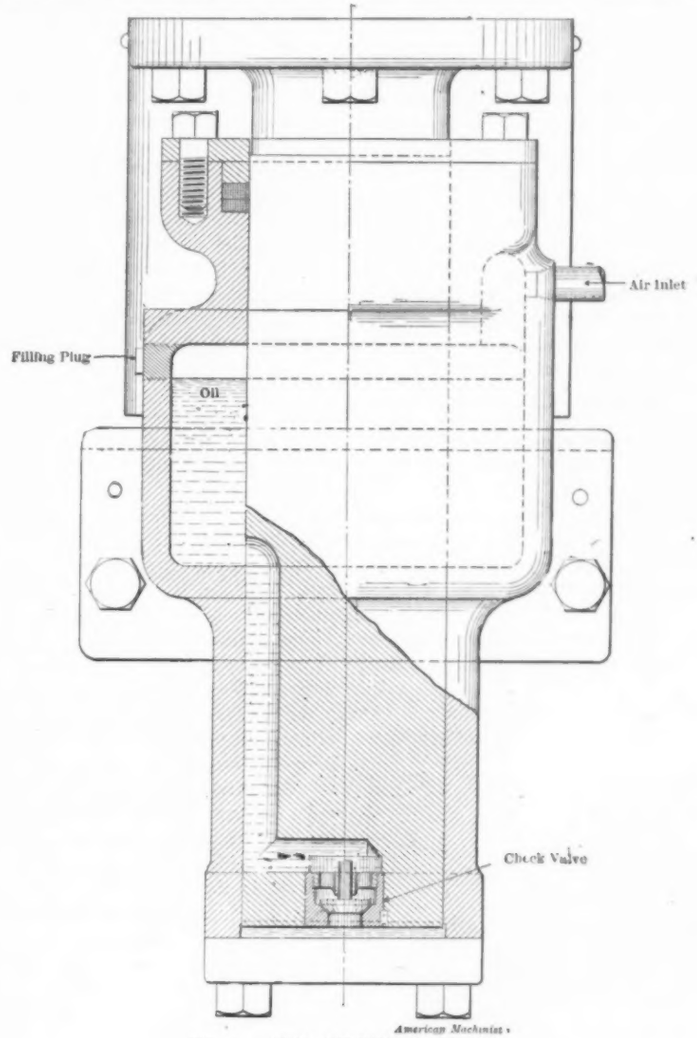


FIG. 2. NEW MOLDING MACHINE.

In Fig. 2, which is a vertical section through one of the cylinders, the arrangement for protecting the packing around the plungers is shown. The cylinder in which the plunger works has near its upper end an annular swelling, which is partly filled with oil when the plunger is down. When air, usually at about 80 pounds pressure, is admitted through the pipe shown, into the space above the oil, the oil is forced through the channel or groove in the side of the plunger, through the small openings shown in the check valve at the bottom, and so displaces the plunger and lifts the top of the

machine. Thus the packing is exposed only to *air* under pressure. When the air pressure is released the weight of the top of the machine and the plungers causes the latter to descend and force the oil through the check valve which opens and allows a rapid passage through it. The controlling valve is visible in the center of the half-tone illustration, and from it the air pipes lead to the four cylinders.

When the machine is used in an inverted position, as it is not necessary to use compressed air there is no tendency for the oil to leak past the packing and cause an objectionable waste and mess.

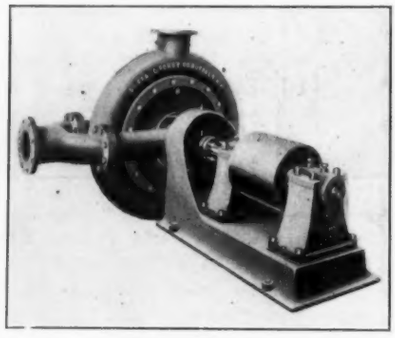
The projecting surfaces of the plungers are protected from the sand by a sheet-steel casing, shown attached to the top of the machine.

This machine is made by the E. H. Mumford Company, of Philadelphia.

TURBINE CENTRIFUGAL PUMP.

The illustration shows a turbine centrifugal pump designed for extreme heads and volumes.

The centrifugal turbine pump has been developed by the builders of this machine to successfully operate with high efficiency under any combination of head and volume. They are built either single or multiple stage, as desired. The principles upon which the designs of these pumps are founded are similar to those applied to the design of water turbines. The water ways, impeller blades and vanes are



A TURBINE CENTRIFUGAL PUMP.

designed to reduce the loss by slippage, shock, internal friction and leakage to a minimum. The peripheral shell is designed to avoid vibration with its accompanying friction losses. The two side plates which carry the suction elbow or elbows, as the case may be, are fastened to the shell by studs. These pumps possess the advantages of simplicity of parts, freedom from wear and ability to handle large particles of solid matter, such as mud, sand, sticks, ore and even small stones without in any way interfering with their operation. Although the pump here shown is fitted with a pulley for belt drive, they are as often direct-connected to Buffalo high-speed engines or to electric motors. Their arrangement may be varied to suit the demands in each case.

They are manufactured by the Buffalo Steam Pump Company, Buffalo, N. Y.

Difficult Molding-Machine Work.

BY R. ADAMS.

In the use of the molding machine, as in all trades and arts, there are special tricks and expedients which can at times be advantageously employed. Frequently in my visits to different foundries I have come across jobs which would require these special schemes; upon asking the foreman why he sticks to the old method of molding, he will say, "Oh, that can't be made on a machine; how would you ever get that pocket out, and what will you do with this loose piece?" I am not always prepared to answer these questions on the spot, as some of them are very difficult at first sight, but before returning his way again I manage to study the problem out, and in many instances I have been instrumental in getting these crooked pieces made on the molding machine.

The molding machine, in which I am a great believer, is but one of several improvements which are being made in foundry practice. One of these is, as the result of its reduction in price, the use of aluminum, which makes a fine, light pattern; another is the vibrator operated by compressed air, instead of the old-style rapping bar through the top of the cope; the vibrator saves breaking the patterns from the gates and does much toward turning out uniform work. In my opinion, the most valuable improvements in the future will be in the pattern line, enabling patterns with very crooked parting lines to be duplicated perfectly, and very cheaply, making it possible for a poor foundry to mount any pattern they desire.

A THREE-PARTED JOB ON THE MOLDING MACHINE.

Three-parted work is considered by some men to be out of the molding-machine line because they don't know how to mount it, so I will show a rather difficult case mounted on a machine. A view of it can be seen in Fig. 1. In this casting, before it was made on the machine, the lugs *V* were not cast in, but were made separate and the shell *D* drilled and tapped for them; this was extra expense which is now done away with since the molding machine came into play. The machine for this section of the pattern was made specially for the purpose, though when the order is run out the machine can be used for other patterns. The only special feature of the machine itself is that it is very deep from the stool plate up to the stripping plate. The parting line for this job will be noticed in Fig. 1. Three machines, shown in Figs. 2, 3 and 4, are used. The drag is equipped with a very interesting mechanical device which I will attempt to explain, believing that others may have use for a similar device on their patterns. Through the central hole in this section of the pattern passes a standard which serves a double purpose: first, it forms the stool, which stool in turn supports the sand when the pattern is withdrawn from the mold; second, the sides of the standard form a support and guide for the mechanism for pulling the teeth *V* from the sand. This device is operated by means of the wheel *Y* which screws up and down on the screw *W*-1, Fig. 10; above the hub of the wheel is a U-shaped bracket *Y*-1, and within this bracket is a washer, see Fig. 10, which overlaps the top and bottom surfaces of the wheel hub and has longitudinal pieces passing through the center hole of wheel alongside of flats made on the side of the screw *W*-1, Fig.

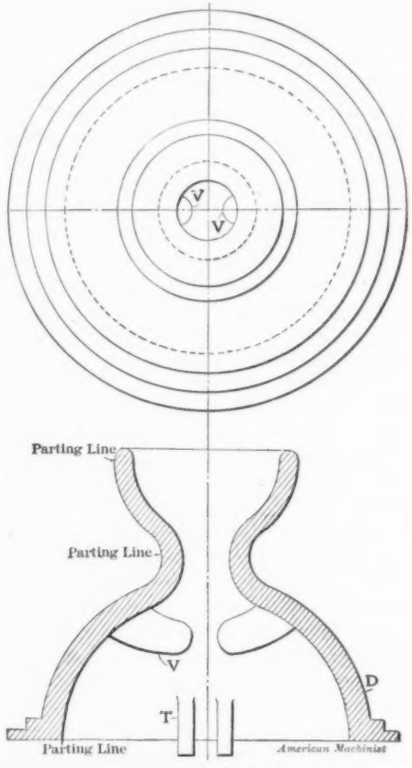
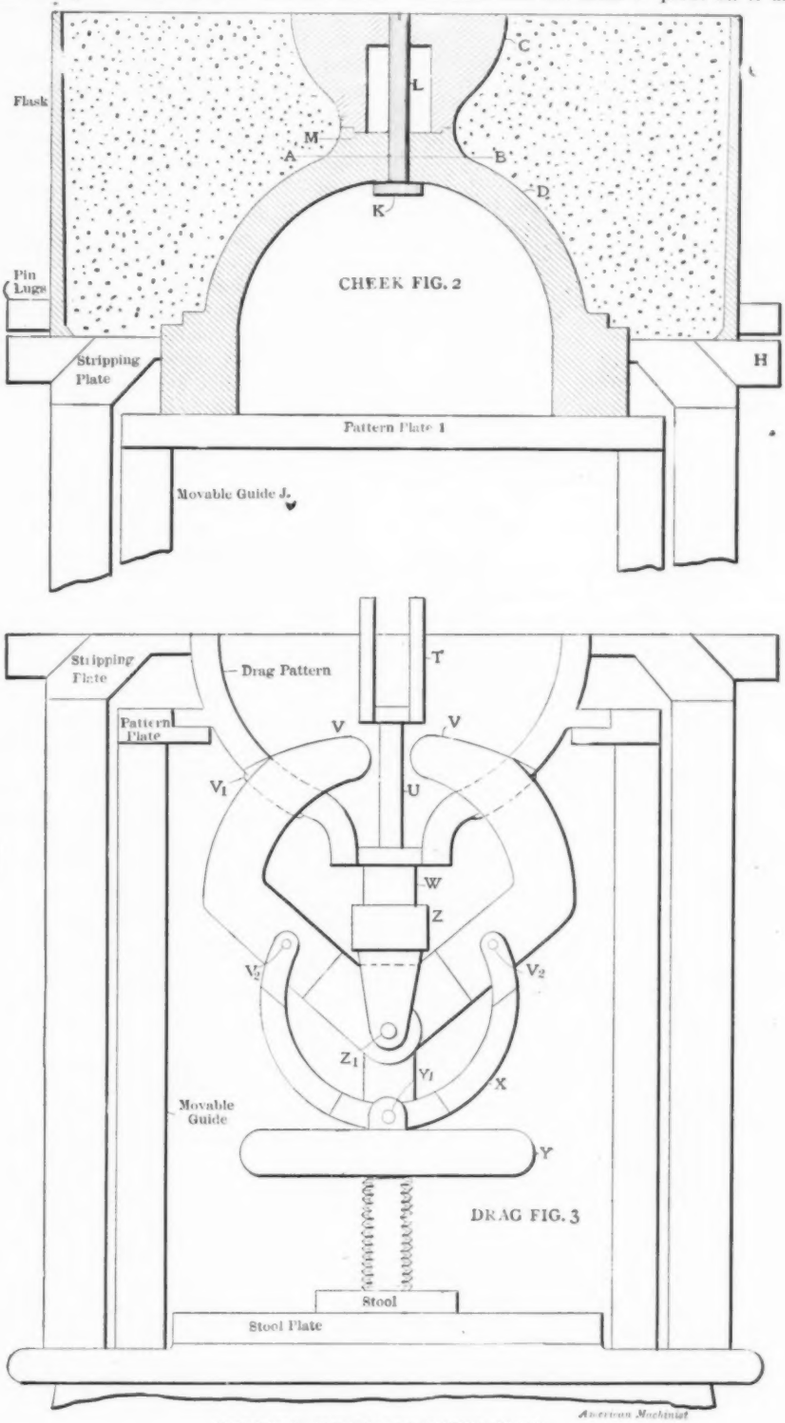


FIG. I. THE CASTING TO BE MADE.

10, these connecting strips on each side of the screw holding top and bottom washers together. By this means the screw can be worked up or down on the screw *W*-1, and the washers will follow, carrying along the U-shaped bracket and the whole device up and down alongside of the screw *W*-1, Fig. 10. In the ends of the two uprights of the U-bracket are drilled holes, a better view of which can be seen in Fig. 9. Making the screw in a separate piece from the stool *W* facilitates getting the wheel, washer and U-bracket in place, as seen in Fig. 10. The connecting arms *X* are made so that they will fit the sides of the stool and the screw *W*-1, which is about three-eighths inch wide across flats, the flattened sides of the screw keeping all parts from revolving around the stool.

The other end of the arm X is made in a similar fashion and takes hold of the arm V, being connected thereto by a rivet so that it can work freely when the wheel is turned; see Fig. 7. The forked ends that are pin-connected to V are the same on both castings X, but the other ends are different on the two castings, as one must straddle the other; see X, Fig. 10. The lower ends of the arms V are made of the same shape as the lower ends of arms X, as one must straddle the other in a similar manner, also spanning the flat of the stool. But the connection at the end of V differs from that at the end of arm X, inasmuch as V has a hole clear through the arms and the stool itself, thus securing it there, a pin being driven in this hole and the arms V pivot on it and pull out of their respective openings in the pattern when the hand wheel is turned. The pivot pin for the end of the arm X passes only through the U-bracket and the ends of the arms; hence two pins are required, one on each side, which are driven hard into the hole in the U-bracket.



DIFFICULT MOLDING-MACHINE WORK.

The casting Z is a support to the ends of the arms V, and stiffens the stool, as the stool is made weak by drilling a hole through it for the pivot pin in the ends of V. The casting Z is drilled to fit the stool W. On the sides of the arms V are flanges V-1, so located as to keep V from entering the pattern further than it should. It can now be seen how this device performs its work, by the turning of the hand wheel, which when screwed far enough down the screw W-1 brings the ends of the fingers V below the pattern proper, so that the pattern by the regular crank motion found on the side of the machine can drop the pattern down through the stripping plate a sufficient distance to strip all the parts where necessary.

The part T in Fig. 3 has straight sides; there are two pieces on each side. These pieces T must be stripped, which is done by means of the two stools designated by U, the stool resting on the steel plate below. The purpose of the two lugs T is to form a guide for a slide which works back and forth between the two fingers V; on the end of this slide is a movable rod, having a ball on the end of it. When the slide works a certain distance the ball hits the ends of the fingers V, which check it and cause it to reverse and return. These fingers need no finish, but the inner surfaces of the guides T are milled.

THE DRAG PORTION OF THE PATTERN.

In making the drag pattern, a master pattern must be first made, and on the outside of it, in line with the pattern plate, is fastened a flange with a flat surface, so that it can rest in a ledge in the pattern plate. The shape of this pattern is round and about 3/8 inch thick, while at the point that comes in contact with the stripping plate it is made to come square with the inside edge of the plate, a finish being allowed at this point, and also at the under side of the flange. Where the arms V enter the pattern there is a boss on the outside of the pattern; this is also finished true with the inside of the pattern. The lugs T are not cast on the pattern, but are finished and fastened in place when the center of the pattern is finished to size. The parts V, W, X, Y, Z, are brass castings, while the U-bracket Y-1 is made out of sheet steel. The shape of the stripping plate can be seen in Figs. 2, 3 and 4.

THE CHEEK PORTION OF THE PATTERN.

In the construction of this section, two loose patterns are necessary, for otherwise it would be necessary to make two parts of this portion of the mold. The outer outline of this cheek section corresponds exactly with the outline of the casting seen in Fig. 1, while the interior of the cheek section in the large half is cast hollow for the purpose of lightening it. On the top face of the large cheek pattern is turned a recess about 1/8 inch deep and designated by M in Fig. 2; the object of this recess is to locate the two portions

of the cheek patterns so that the outlines come true with one another. The small end of the small cheek pattern has a pocket cast in it, which lightens the pattern. In the center of this small section is fastened a steel pin *L*, the end of which is made flat, ¼x½x⅛ inch. In the top of the large section of the cheek pattern is drilled and filed a hole to the shape of the end of the steel pin, only a trifle larger and also tapering so that the end of the pin will have no difficulty in finding it. The surface on the inside of the large portion, around the hole for the pin, is so formed that when the pin is turned half-way around it tightens up and holds fast the two sections of the cheek pattern (see Fig. 5 for a sectional view of this locking device). Two finger-grip openings are made in the top surface of the small portion of the pattern, so that the operator of the machine can readily take the top pattern from the lower one, thus making it possible to draw the larger pattern away from the sand without tearing up the sand. The drawing of the pattern is done by the usual method of a crank on the side of the machine, not shown in the cut.

THE COPE PORTION OF THE PATTERN.

In making the pattern of the cope section *E*, the pattern is split in the small neck; all that is not contained in the drag is made in the cope. The center of the pattern has a hole in it of the same diameter as the drag pattern at smallest part, and through this hole works a stool *P*; the top of the stool comes on a line with the division of the drag and cope patterns, so the small end of the cope pattern must be made long enough to surround the top of the stool *P* so as to hold the stool in place. The top of the stool supports the green sand core formed in the cavity in the cope pattern. The outer surface of the cope pattern conforms to the interior and is ⅜ inch thick, and on the outside is the flange *Q* which supports the pattern on the pattern plate in a similar fashion to that in which the drag pattern is supported. On the top, at the mouth of the large opening, the pattern has a half-round form, which comes above the stripping plate, as shown in Fig. 4; a gate and runner *F* is fastened to this half-round section. The stool *P* is fastened down to the top of the stool plate *N*. The stool plate, pattern plate and stripping plate are formed in a similar way to those in the drag section of this job. The pattern is dropped down through the stripping plate by means of a crank on the side of the machine, but not shown in the cut, which moves the movable guide *J* up and down as needed. This completes the description of the three sections.

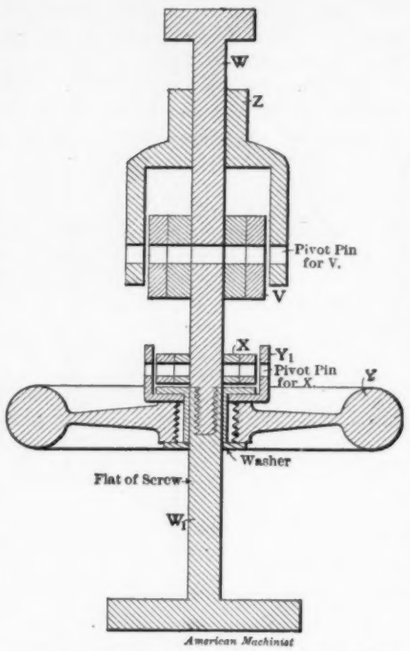


FIG. 10. DIFFICULT MOLDING-MACHINE WORK.

THE FLASKS.

The flasks for this job are made of iron in three sections, namely, drag, cheek and cope, the cheek section only of flask being shown in the cut to show its relative location with the top surface of the pattern *C*, Fig. 2; these flasks, according to the usual custom, are fitted with steel pins.

MOLDING.

To make a mold of this job, first set the iron flask on the drag machine, having all sections of the pattern in their places, as shown in Fig. 3; then put in some sand in the bowl of the pattern and tuck it securely around the fingers and in the guides *T*; then fill up the flask with heaped sand, and ram in the usual way; then, after venting, turn the hand-wheel which withdraws the fingers out of the sand and away from the pattern; then by the crank at the side of the machine, drop the remainder of the pattern down away from the sand and stripping plate. Lift the drag off the machine and set it on the floor; then set the cheek section of the flask on the cheek-molding machine and secure the portion *C* to the portion *D* by turning the section *C* till pin *K* locks under the flat side of pattern *D*; then put in the sand and tuck it around the pattern in the section of the small neck; then fill up the flask and ram it in the usual way, scrape off the top flush with the flask line, this flask line being finished on each flask; then remove the section by the turning of the top small section of the pattern; then lift it out and by the aid of the crank of the machine, draw the remainder of the pattern from the sand; then lift the cheek section off the machine, and set it on the drag and proceed to make the cope by setting the cope section of the flask on the cope machine; set in the sprue and fill up the flask with heaped sand and ram in the usual way; strike off the top of the mold

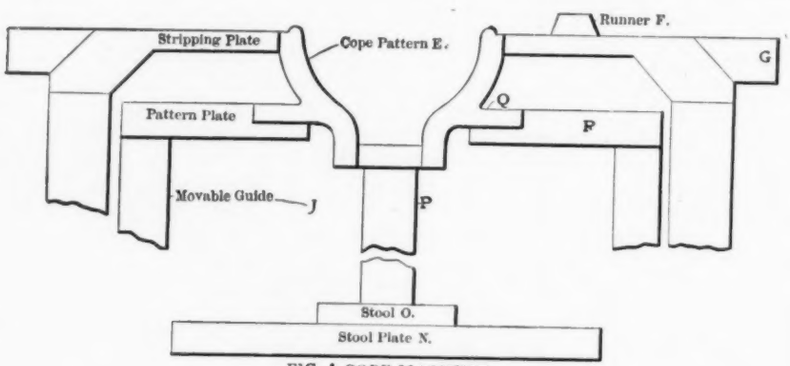
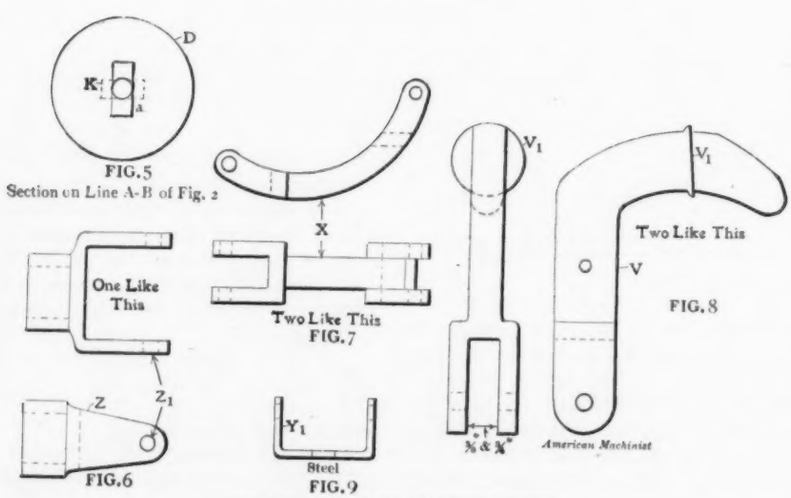


FIG. 4 COPE MACHINE



DIFFICULT MOLDING-MACHINE WORK.

and draw the sprue, vent the mold; then draw the pattern down through the plate out of the sand by the crank of the machine, lift off the cope from the machine, and set it on the cheek. This, then, will complete a perfect mold from this set of patterns.

Personal.

F. W. Reed, of Craven Bros., engineers, Manchester and Reddish, England, is making a tour of this country, accompanied by Mrs. Reed.

George A. Gauthier has resigned his position with the New Britain Machine Company to become chief draftsman for the Universal Machine Screw Company, of Hartford, Conn.

H. F. Stratton, who has been connected with the principal office of the Electrical Controller & Supply Company, at Cleveland, Ohio, has accepted the position of New York representative of the same company, with offices at 136 Liberty street, New York city.

Obituary.

Vernon H. Rood, vice-president and general manager of the Jeanesville Iron Works, Hazleton, Pa., died suddenly, September 3, at Bad Naudheim, Germany, where he had gone for the benefit of his health. Mr. Rood was forty-eight years old. He was born in Elyria, O., November 10, 1856. He was a graduate of Stevens Institute of Technology. Shortly after his marriage he located at Jeanesville. For the past fifteen years he has devoted his entire time and energy to the perfection of mine pumps, and during that time he achieved a great deal of success. Mr. Rood was very highly esteemed by those whose privilege it was to know him. He had been a member of the A. S. M. E. since May, 1886.

Manufacturers.

The Conestoga (N. Y.) Traction Company will erect a new power plant.

A $150,000 warehouse will be erected for Leopold Vilsack, Pittsburg, Pa.

The Carnegie Steel Company will erect a new pig mill at New Castle, Pa.

The Cincinnati (O.) Iron Fence Company will erect a new $15,000 factory.

Rhode Bros., Reading, Pa., bicycle manufacturers, will erect a new factory.

The Vulcan Foundry Company, of Hamilton, O., will erect a new foundry.

The Crescent Excelsior Company, Fredericksburg, Va., is erecting a new plant.

John B. Agen & Co., Willmar, Minn., expect to erect a new cold-storage plant.

John Huyler, candy manufacturer, New York, will erect a new ten-story factory.

The Gross Lumber Company, Bellevue, O., is preparing to build a fine new modern plant.

The Excelsior Wrapper Company, Sheboygan, Wis., is erecting a new excelsior factory.

Plans are being drawn for the new factory of the Wallace Sprayer Company, Champaign, Ill.

The Evansville (Ind.) Metal Furniture Company will erect two new factory buildings.

E. D. Thayer, Worcester, Mass., will erect an addition, which will be used as a pickerroom.

W. S. McKee, Allegheny, Pa., manufacturer of molds for glass factories, will erect a new plant.

The Oster Manufacturing Company, Cleveland, O., special tools, etc., is building a new factory.

The Cleveland (O.) Machine & Manufacturing Company will erect an addition to its factory.

The contract for the Shaw Machine Company's plant, at Lowell, Mass., has been awarded.

The plant of the Lincoln Car Company, Greensboro, Ind., was destroyed by fire; loss, $100,000.

The Chicago & Eastern Illinois Railroad will erect new freight yards and roundhouses in Salem, Ill.

The Greenwich Bleachery Company, East Greenwich, R. I., has decided to erect another large addition.

The plant of the Atlanta (Ga.) Tanning & Manufacturing Company was burned; loss, about $25,000.

The J. H. Sessions & Son Company, Bristol, Conn., making trunk hardware, will build a new factory.

Borden Brothers & Co.'s stave factory, at Manassas, Va., has been burned. It will probably be rebuilt.

The Climax Manufacturing Company, Corry, Pa., will build an addition, to be used as an assembling room.

Solomon Scam, South Norwalk, Conn., will establish a factory for the manufacture of brass goods, etc.

The Union Pacific Railroad will erect new shops in Omaha, Neb., where it will build its own locomotives.

The Utica & Willowvale Bleachery Company, Chadwicks, N. Y., will build an addition to its plant.

The chair plant of the Hadley Manufacturing Company, Manchester, Vt., was destroyed by fire; loss, $30,000.

The Merchants' Refrigerating Company, Louisville, Ky., will put up a new ice factory in South Louisville, Ky.

The Rhode Island Malleable Iron Works, Hills Grove, R. I., will make improvements and increase its output.

The plant of the Casein Company of America, at Bainbridge, N. Y., was burned, entailing a loss of $10,000.

The Northwestern Lumber Company, Hoquiam, Wash., will erect a $12,000 brick burner for its refuse product.

The Hersey Manufacturing Company, Boston, Mass., water meters, is figuring on the erection of a $25,000 factory.

The Advance Stove Works, Evansville, Ind., has planned a new steel range factory as an addition to its present plant.

The McConnell Manufacturing Company, Hornellsville, N. Y., sashes, doors, blinds, etc., is putting up another building.

The American Metal Company, Indianapolis, Ind., will erect a new factory. The company manufactures mail boxes.

The New Castle (Pa.) Forge & Bolt Company is erecting a new plant to replace the one recently destroyed by fire.

The Campbell, Smith & Ritchie lumber and furniture factory, Lebanon, Pa., was partially destroyed by fire; loss, $25,000.

The Hampton (Ga.) Fertilizer Company has been organized and will erect a large factory. W. M. Harris, president.

The factory of the London (Ont.) Box Manufacturing & Lumber Company was dedestroyed by fire; loss, $40,000.

The machine shops and foundry of Strickland Bros., Tuscaloosa, Ala., were destroyed by fire, entailing a loss of $60,000.

Permit has been issued for a new factory building for Schaum & Uhling, Philadelphia, Pa., builders of textile machinery.

The Jamestown (N. Y.) Panel & Veneer Company, whose plant was recently destroyed by fire, has commenced to rebuild.

Plans have been received for a powerhouse to be erected in connection with the Naval Hospital, Washington, D. C.

The Eastern States Refrigerating Company, with plants in Albany and Jersey City, will erect one in Springfield, Mass.

The Semet-Solvay Company, Milwaukee, Wis., will double the capacity of its plant, expending $250,000 in improvements.

The American Car & Foundry Company, with headquarters in St. Louis, Mo., will probably erect a plant in Alabama.

The Philip Carey Manufacturing Company, Lockland, O., asbestos materials, is preparing to increase the capacity of its plant.

The sash and door factory of the Werheim Manufacturing Company, Wausaw, Wis., was damaged by fire to the extent of $16,000.

The Caledonia (N. Y.) Hardwood Lumber Company will erect a sawmill. Samuel Murdoch, of Batavia, N. Y., will have charge.

The Kansas City (Kan.) Milling Company, whose plant was recently burned, has filed articles of incorporation and will rebuild.

The Colorado plant of the American Zinc & Chemical Company, of Pittsburg, Pa., was destroyed by fire, entailing a loss of $75,000.

The Lawrence Manufacturing Company, Lowell, Mass., is erecting a new hosiery mill, to give employment to about 200 extra hands.

The seed plant of the Albert Dickenson Company, Minneapolis, Minn., is being doubled and the entire plant will be run by electricity.

The Standard Portland Cement Company, of San Francisco, Cal., will erect a plant near Santa Cruz at an estimated cost of $2,000,000.

The Colorado State Commercial Association, Denver, Colo., is looking for a location for a woodenware plant, to employ over 150 men.

The American Manufacturing Company, of Washington, D. C., has decided to establish its Western automobile factory in Milwaukee, Wis.

The Granite Linen Company, 370 Broadway, New York, is having plans prepared for the rebuilding of a factory in Wortendyke, N. J.

Lewis Elmer & Sons, Baltimore, Md., will erect a vinegar and pickling plant, which will consist of four buildings, including a boilerhouse.

The Lafayette Worsted Mill, Woonsocket, R. I., will erect an addition, to be used as a wool-washing plant, and make other improvements.

The Singer Manufacturing Company, Elizabeth, N. J., will build a large addition to its plant, and, it is said, will employ 3,000 more people.

The King Canvas Boat Company is erecting a plant in Muskegon, Mich. George H. Winans, of Kalamazoo, is at the head of the concern.

The Oregon Handle Manufacturing Company, Newburg, Ore., whose plant burned down recently, will rebuild on a larger and improved plan.

New Catalogs.

The Billings & Spencer Company, Hartford, Conn. 1906 price list of drop-forged machine wrenches. Illustrated. 3½x6, pp. 39, paper.

Three Rivers Tool Company, Three Rivers, Mich. 1905 price list of Matthews core drills and reamers. Illustrated. 3½x6, pp. 6, paper.

Niles-Bement-Pond Company, 111 Broadway, New York. Catalogue of electric traveling trolleys and hoists especially designed for loads of one-half to five tons. This contains very fine half-tone illustrations and line drawings. 9x12, pp. 23, paper.

Crane Company, Chicago, Ill. Advance Circular No. 6 CLJ, illustrating and describing No. 181 E Cranelap extra heavy flanged pipe joints with swivel flanges, and Advance Circular No. 9 CWJ, illustrating and describing No. 295 E Craneweld flanged pipe joints with wrought-steel flanges. Illustrated. 6x9.

The Darling Pump & Manufacturing Company, Williamsport, Pa. Bulletin No. 3, illustrating and describing fire hydrants. 6x9, pp. 8. Bulletin No. 4, illustrating and describing "Standard" 300-pound test-gate valves. 6x9, pp. 20. Bulletin No. 5, illustrating and describing "Medium" 325-pound test-gate valves. 6x9, pp. 55. Bulletin No. 6, describing "Special" 350-pound test-gate valves. Illustrated. 6x9, pp. 41. Bulletin No. 8, illustrating and describing "Heavy and Extra Heavy" 700-pound and 1,000-pound test-gate valves. 6x9, pp. 28. Bulletin No. 9, illustrating and describing "Hydraulic and Heavy Hydraulic" 1,600-pound and 2,000-pound test-gate valves. 6x9, pp. 16.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Working drawings made for everything. "Cushman," 303 Broadway, Cambridge, Mass.

Dies and tools for sheet metal designed and constructed; estimates. J. V. Woodworth, 367 Vernon ave., Brooklyn, N. Y.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Manufacturers—If you have any new goods or devices, we want to introduce them for you in this vicinity. Wolverine Supply Co., Pittsburg, Pa.

Shop Economics!—Interested? See September *Marine Engineering*, and let me know if a competent man can be useful to you. Lucas, 120 Meserole ave., Brooklyn.

Wanted—A small machine shop near foundry. Give details of work now doing, description of tools and property, location, terms, etc. Box 589, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Clock-Making Machinery.—Wanted—Lists of most modern tools for above trade; lathes, wheel-cutting and special labor-saving machines. Address Gillett & Johnston, Croydon, England.

Manufacturers' Agents.—We are prepared and desire to represent manufacturers of devices new in this territory. G. S. Carter Machinery Co., 225 North First st., Minneapolis, Minn.

Incorporation of mechanical industries, and other legal matters relating thereto, specialized. Correspondence solicited. Send for references. Fred'k P. Schenck, N. Y. and N. J. Counselor, 141 Broadway, New York.

For Sale.

For Sale—One Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

For Sale—A quantity of Hermann Boker flat steel, all thin, ¼ to 1 in. width; also a quantity of Phoenix drill rod, sizes 15-55; all will be sold very cheap if entire quantity can be closed out. Address Box 581, AM. M.

Business Opportunities.

I want some device or specialty that will form basis of a manufacturing business; would take a partner. B. F. B., 1020 Westinghouse Bldg., Pittsburg, Pa.

Partner wanted in pattern and wood-working business clearing $5,000 yearly; little money required and favorable arrangement made with right man. Box 600, AM. MACH.

A foundry superintendent, a mechanical engineer, a foundry foreman, an architectural draftsman, also good inside business man—all wanted for thriving foundry company, making castings. Volume $90,000. New associate must invest in company's approved securities. High standing. Right salaries. Box 602, AMERICAN MACHINIST.

A Liverpool, England, commission agent wishes an additional agency to work with present lines; 26 years' connection among ironmongers, contractors, etc.; understands import and distribution of goods; could handle American goods to advantage in the United Kingdom; references furnished and required. Reply to Box 573, AMER. MACH.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

GEORGIA.

Wanted—Position, by young man, as general foreman or superintendent; experienced in repair work, gas engine, steam engine, ice machinery and general jobbing; competent to make estimates, design new work, design special tools and to systematize a shop in an up-to-date manner; have successfully designed an air-cooled gas engine of stationary type up to 6 H.-P.; am at present holding position as superintendent; can give excellent references; good reason for wanting to change. Address Box 575, AMERICAN MACHINIST.

ILLINOIS.

Spanish-speaking American, mechanical engineer and designer, technical graduate, practical machinist, 12 years' experience on design of machine tools, automatic, textile, mining, hoisting machinery, mill plans, power transmissions, etc., desires responsible situation, master mechanic, foreman, salesman, construction boss, or similar mechanical position, in Spanish-American republics; Mexico preferred. Address Box 603, AMER. MACH.

MICHIGAN.

First-class patternmaker and inventor would like change. Box 593, AMER. MACH.

Superintendent wants position; New England man; age 39; good executive and mechanical ability; capable of installing system and handling men to advantage; excellent references. Box 594, AMERICAN MACHINIST.

NEW YORK.

Experienced cost clerk desires position. Box 559, AMERICAN MACHINIST.

Mechanical draftsman wishes position. Address Box 587, AMERICAN MACHINIST.

Draftsman, mechanical and structural, wants position. Box 533, AMER. MACH.

Draftsman, designer, experienced, seeks position. Box 609, AMERICAN MACHINIST.

A first-class mechanical draftsman wants night or home work. Box 595, AMER. MACH.

Superintendent or manager, age 35, thorough mechanic, desires position; A1 references. Box 607, AMERICAN MACHINIST.

Mechanical draftsman, 2 years' experience, desires position; must be in New York city. Address Box 596, AMERICAN MACHINIST.

Machinist, 27 years old, 12 years' experience, general work, wants position; has some technical training. Box 604, AMER. MACH.

Young man, college education; shop experience and in making drawings in tool machinery; want to change. Address Box 608, A. M.

Foreman, thorough mechanic, age 29, inventive and executive ability, desires change; steam or gas engines preferred. Address Box 583, AMERICAN MACHINIST.

Position wanted as superintendent or general foreman of machine shop; progressive and up to date; can furnish best of references. Box 601, AMERICAN MACHINIST.

General foreman, responsible man, progressive, expert machinist, experienced in high-grade duplicate and general machinery, is open for engagement. Box 611, AM. MACH.

Wanted—A position as superintendent or general foreman, by a thorough, up-to-date mechanic; 20 years' experience in the machine-tool and automobile business. Address Box 597, AMERICAN MACHINIST.

Wanted—Position, superintendent, foreman or toolroom foreman, by superintendent with wide practical experience; technical education; expert tool designer; location immaterial. Box 599, AMERICAN MACHINIST.

Position chief engineer or master mechanic; thoroughly understand engines, boilers, dynamos, motors, manufacturing machinery, etc.; good executive ability; assume full responsibility; first-class mechanical engineer; first-class references. Address Box 545, AM. M.

OHIO.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

RHODE ISLAND.

Young draftsman, last 4 years on power presses and special machinery, some designing, wants position. Box 598, AMER. MACH.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Wanted—First-class toolmakers for bending, forming and sub-press dies; state experience and wages wanted. Ross Rifle Co., Quebec, Canada.

Wanted—First-class general foreman for wire insulating factory in Canada, where rubber covered weather proof, magnet and general insulated wires are made; state wages and experience. Box 564, AMERICAN MACHINIST.

CONNECTICUT.

Wanted—Salesman to handle quick-selling side line, small bench tools. "Gardner," care AMERICAN MACHINIST.

ILLINOIS.

Feed and speed foreman for a machine shop employing 75 machinists on large and small machine tools; man with energy and aggressiveness wanted; state age, past experience and salary desired. Box 567, AMER. MACH.

Wanted—Man for forge department, by large manufacturing concern; must be a competent drop forge die and tool designer, thoroughly posted on modern shop methods, with ability to handle men; an exceptionally good opening for the right man; no attention paid to applicants who do not state age, salary expected and full particulars regarding experience. Box 568, AMERICAN MACHINIST.

INDIANA.

Wanted—A mechanical engineer; must be well versed in steam engineering, electrical work, machine shop practice, machine designing, wood and iron working machinery, and general maintenance of a large manufacturing plant; give details of experience and education. Studebaker Bros. Mfg. Co., South Bend, Ind.

MASSACHUSETTS.

Wanted—Young man, experienced in gear work, for office and shop assistant. Boston Gear Works, Boston, Mass.

MICHIGAN.

Draftsman wanted, for checking drawings and assisting chief draftsman, by large automobile company located in Detroit; he must be somewhat familiar with gasolene engines and automobiles and thoroughly familiar with tool designing for manufacturing on interchangeable plan; permanent position for right person; give full particulars, including wages expected and references. Box 584, AM. M..

Wanted—Immediately, several toolmakers; men who have had experience making jigs, fixtures and tools adapted to manufacturing parts of accurate machinery on the interchangeable plan, by modern machinery and appliances. (If you have not had such ex-

perience, please do not answer this advertisement.) To experienced and competent men, of good character, who can secure results, steady work and attractive wages; state age, qualifications, references. Cadillac Automobile Company, Employment Bureau, Detroit, Mich.

NEW JERSEY.

Wanted—Draftsman for tool, fixture and general shop equipment; shop experience essential. Address Box 605, AMER. MACH.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Wanted—An assistant superintendent for a machine shop near Philadelphia, employing about 400 hands, on small interchangeable work; a thoroughly systematic man, experienced in the handling of men, who can produce, economically, duplicate work in large quantities, without excuses, is required; do not apply if you are not worth $3,000 per year to us; applicants are requested to state where now employed, length of time of such employment, age, references and qualifications for this position. Address Box 540, AM. M.

NEW YORK.

Wanted—Foreman toolmaker, pump shop, Greater New York; state experience, references. Box 610, AMERICAN MACHINIST.

Machinists—Several steady jobs open for tool, vise and erecting men competent to fill them. Watertown Engine Company, Watertown, N. Y.

Wanted—Lathe hands for day and night shift; steady positions assured to sober, industrious men. Address, with references, Imperial Engine Co., Painted Post, N. Y.

Several experienced draftsmen wanted on construction work; location, N. Y. city; permanent positions to good men; state age, nationality, experience and salary expected Box 590, AMERICAN MACHINIST.

Wanted—Day and night foremen for machine department, capable of producing the best possible results with modern tools; good positions for men willing to show results; state age, experience and give references. Box 534, AMERICAN MACHINIST.

Wanted—Superintendent with experience in the manufacture of first-class machine tools; must be energetic, with good executive ability; technical graduate preferred; an excellent opportunity for the right man; state age and past experience. Address "Machinery Manufacturer," care AMER. MACHINIST.

Wanted—Experienced men for our mechanical engineering department, to specify orders for shop; technical graduates with drafting-room experience preferred; state age, experience, reference and salary expected. Apply by letter only, Mech. Eng. Dept., Otis Elevator Company, Yonkers, N. Y.

Chief cost clerk, also a storekeeper, wanted by a company manufacturing a wide variety of metal goods and employing 2,000 hands on both very heavy and light machinery; applicants should state experience and fully explain the working of systems with which they are familiar; all communications, including any forms, etc., enclosed, will be treated confidentially; salary according to qualifications. Address "Production," care AMER. MACH.

OHIO.

Wanted—Designers and detailers on heavy machine tool work; state age and experience. The Niles Tool Works Co., Hamilton, Ohio.

Draftsman wanted; technical graduate with some experience; steady man, willing to learn. Address P. O. Box 876, Cincinnati, O.

Wanted—Two draftsmen, with crane experience preferred. Apply, giving experience and salary expected, to the Case Manufacturing Company, Columbus, Ohio.

PENNSYLVANIA.

Vise hands or fitters on machine tool work; modern shop; no trouble; applicants should state past experience. Standard Engineering Co., Ellwood City, Pa.

Wanted—Foreman or first-class machinist, capable of handling men to advantage; to take charge of machine hands in elevator shop. Box 592, AMERICAN MACHINIST.

Machinists wanted; men familiar with vise and lathe work; those accustomed to medium class of work preferred; steady work and good pay to the right men. Box 591, AM. M.

Wanted—In southern Pennsylvania, a mechanical draftsman and designer, familiar with machine shop practice, for machine tool work; in reply, state experience, references and wages wanted. Box 548, AMER. MACH.

Wanted—Good, live hustler as foreman for machine shop; gray iron work; must be accurate workman and capable of handling jig work; good pay to right man; give full particulars as to age, experience, etc. Address The Taper-Sleeve Pulley Works, Erie, Pa.

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Alphabetical Index to Advertisers.

PAGE

Abrasive Material Co. 100
Acme Machinery Co. 34
Adams Co., The 114
Albro-Clem Elevator Co. 98
Almond Mfg. Co., T. R. 94
Alteneder & Son, Theo. 100
American Gas Furnace Co. 14
American Pulley Co. 113
American Tool Works Co. 8
American Tube & Stamping Co. 24
American Watch Tool Co. 104
Armstrong Bros. Tool Co. 30
Athol Machine Co. 110
Auburn Ball Bearing Co. 102
Automatic Machine Co. 105

Backus Water Motor Co. 120
Baird Machinery Co. 90
Baker Brothers 30
Baldwin Chain & Mfg. Co. 93
Baldwin Steel Co. 103
Ball Bearing Co. 34
Barnes Co., B. F. 100
Barnes Co., W. F. & John 14
Barnett Co., G. & H. ..... 4th Cover
Bartlett, E. E. 112
Bates Machine Co. 100
Baush Mach. Tool Co. 91
Bay State Stamping Co. 121
Bay State Tap & Die Co. 101
Beaman & Smith Co., The ..... 15 and 94
Becker-Brainard Milling Machine Co. 23
Bemis & Call Hardware & Tool Co. 30
Bertram & Sons Co., Ltd., John 14
Besly & Co., Chas. H. 16
Bethlehem Fdry. & Mach. Co. 87
Betts Machine Co. 6
Bickford Drill & Tool Co. 1
Bignall & Keeler Mfg. Co. 103
Bilgram, Hugo 34
Billings & Spencer Co. 33
Binsse Machine Co. 34
Birdsboro Steel Foundry & Machine Co. 119
Blaisdell Machinery Co. 101
Blanchard Mach. Co. 34
Bliss Co., E. W. 25
Blount Co., J. G. 22
Boker & Co., Hermann 83
Boston Gear Works 96
Boynton & Plummer 117
Bradford Machine Tool Co. 5
Bridgeford Mach. Tool Wks. 33
Bristol Co. ..... 4th Cover
Brown Co., H. B. 92

PAGE

Brown-Cochran Co. 120
Brown & Co., R. H. 94
Brown & Sharpe Mfg. Co. ..... 73 and 4th Cover
Brown Hoisting Mach. Co. 112
Buffalo Forge Co. ..... 4th Cover
Builders Iron Foundry ..... 3d Cover
Bullard Auto. Wrench Co. 95
Bullard Machine Tool Co. 32
Butler, A. G. 121

Caldwell & Son Co., H. W. 97
Carborundum Co., The 20
Card Mfg. Co., S. W. 17
Carpenter Tap & Die Co., J. M. 102
Case Mfg. Co. 112
C & C Electric Co. 108
Chadwick & Co., G. B. 100
Chambersburg Engr. Co. 87
Chandler & Farquhar ..... 88 and 90
Chattanooga Machinery Co. 100
Chicago Flexible Shaft Co. 25
Chicago Rawhide Mfg. Co. 96
Christensen, N. A. 26
Cincinnati Machine Tool Co. 31
Cincinnati Milling Mach. Co. 7
Cincinnati Planer Co. 9
Cincinnati Shaper Co. 122
Clark Cast Steel Cement Co. 92
Clayton Air Compressor Wks. 93
Cleveland Auto. Mach. Co. 18
Cleveland Cap Screw Co. 29
Cleveland Crane & Car Co. 112
Cleveland Pneumatic Tool Co. 26
Cleveland Stone Co. 92
Cleveland Twist Drill Co., The ..... 4th Cover
Clough, R. M. ..... 96 and 100
Coates Clipper Mfg. Co. 112
Coes Wrench Co. 23
Colburn Machine Tool Co. 22
Columbia Corres. Schools. 87
Columbus Machine Co. 120
Cook Co., Asa S. 94
Crane Co. 121
Crescent Forgings Co. 24
Cresson Co., Geo. V. 95
Crocker-Wheeler Co. 107
Crosby Steam Gage & Valve Co. 17
Cumberland Steel Co. 26
Curtis & Co. Mfg. Co. 26
Curtis & Curtis Co. 30
Cushman Chuck Co. 94
Cutler-Hammer Clutch Co. 108

Dallett Co., Thomas H. 115
Davis, Rodney 98
Desmond-Stephan Mfg. Co. 84

PAGE

Detrick & Harvey Mach. Co. 30
Diamond Machine Co. ..... 3d Cover
Dickinson, Thos. L. 100
Dill Machine Co., T. C. 22
Dixon Crucible Co., Joseph 121
Draper Machine Tool Co. 10
Dreses Machine Tool Co. 92
Druckleib, C. 26

Earle Gear & Mach. Co. 96
Eastern Machinery Co. 95
Eberhardt Bros. Machine Co. 96
Eck Dynamo & Motor Wks. 108
Electro-Dynamic Co. 107
Elmes Engineering Works, Chas. F. 112
Emmert Mfg. Co. 110
Erie Forge Co. 111
Errington, F. A. 95
Evans Friction Cone Co. 102
Excelsior Needle Co. 87

Fairbanks Co. ..... 90 and 119
Farrel Fdry. & Machine Co. 102
Fawcus Machine Co. 98
Fellows Gear Shaper Co. 96
Felton, Sibley & Co. 109
Fenn-Sadler Machine Co. 117
Field, Chas. H. 92
Firth-Stirling Steel Co. 102
Fitchburg Machine Works. 16
Foos Gas Engine Co. 120
Fosdick Machine Tool Co. 15
Franklin Mfg. Co. 104
Frasse, Peter A. 102

Ganschow, Wm. 96
Garvin Machine Co., The 85
General Electric Co. 106
General Mfg. Co. 108
General Pneumatic Tool Co. 27
Geometric Tool Co. 29
Gilmore Electric Co. 105
Gisholt Mach. Co. 28
Gleason Works ..... 4th Cover
Goldschmidt Thermit Co. 103
Gorton Machine Co., Geo. 112
Gould & Eberhardt 77
Graham Mfg. Co. 110
Grant Gear Works 96
Gray Co., G. A. 34
Greaves, Klusman & Co. 109
Greenfield Machine Co. 26
Greenwald Co., I. & E. 96

Hammacher, Schlemmer & Co. 79
Hampden Corundum Wheel Co. 94
Harrington, Son & Co., Inc., Edw. 97

PAGE

Hart Mfg. Co. 116
Hartford Mach. Screw Co. 119
Hartford Steam Boiler Insp. & Ins. Co. 120
Hawkeye Wrench Co. 22
Hemming Bros. 9
Hendey Machine Co. 81
Henley Publishing Co., Norman W. 85
Henry & Wright Mfg. Co. 116
Heppenstall Forge & Knife Co. 98
Herron & Bury Mfg. Co. 26
Hess-Bright Mfg. Co. 101
Hill, Clarke & Co. ..... 90 and 111
Hill-Standard Mfg. Co. 98
Hilles & Jones Co. 90
Hisey-Wolf Machine Co. 113
Hoefer Mfg. Co. 14
Hoggson & Pettis Mfg. Co. 94
Horsburgh & Scott Co. ..... 4th Cover
Horton & Son Co., E. 94
Hunt Co., C. W. 92
Hunt & Co., Robt. W. 120
Huribut-Rogers Mach. Co. 118
Hyatt Roller Bearing Co. 102

Ingalls & Co. 30
Ingersoll Milling Mach. Co. 87
Ingersoll-Sergeant Drill Co. 27
International Specialty Co. 103
Iroquois Machine Co. 30

Jacobs Mfg. Co. 94
Jacobson Mach. Mfg. Co. 120
Jantz & Leist Electric Co. 108
Jeffrey Mfg. Co., The 88
Jenkins Brothers 121
Johnson Machine Co., Carlyle. 114
Jones & Lamson Machine Co. 12 and 34

Kelly Mach. Co., R. A. 118
Kempsmith Mfg. Co. 10
Kent & Co., Edwin R. 102
Keuffel & Esser 100
Keystone Watch Case Co. ..... 88 and 89
King Machine Tool Co. 30

Landis Machine Co. 98
Landis Tool Co. 75
Lapointe Machine Tool Co. 85
Le Blond Machine Tool Co., R. K. ..... 91 and 4th Cover
Le Count, Wm. G. 94
Link-Belt Engineering Co. 86
Lockwood, Arthur J. 103
Lodge & Shipley Mch. Tool Co. 4

	PAGE
Long & Allstatter Co., The	85
Lucas, J. L.	93
Lundstrom Mfg. Co., C. J.	87
Lunkenheimer Co., The	121
McCabe, J. J.	88 and 93
McDowell, Stocker & Co.	90
McGlehan & Co., C. H.	115
Marls Bros.	112
Marshall & Huschart Mch. Co.	89
Massachusetts Saw Works	85
Massey Machine Co.	31
Mechanical Accountant Co.	98
Merrell Mfg. Co.	110
Merrill Bros.	110
Merritt & Co.	121
Messmer Mfg. Co., Ferd.	96
Mietz Iron Fdry. & Mach. Works, August	120
Miner & Peck Mfg. Co.	100
Modern Tool Co.	108
Moore Co., Franklin	113
Morse Chain Co.	100
Morse Twist Drill & Mach. Co.	33
Morton Mfg. Co.	112
Morton & Co., B. K.	102
Motch & Merryweather Mchry. Co.	89
Mueller Mach. Tool Co.	115
National-Acme Mfg. Co.	122
National Corundum Wheel Co.	110
National Separator & Mach. Co.	98
New Britain Machine Co.	118
New Era Gas Engine Co.	120
New Haven Mfg. Co.	115
New Process Raw Hide Co.	97
New Process Twist Drill Co.	30
Newton Mach. Tool Wks., Inc.	11
Nicholson File Co.	17
Nicholson & Co., W. H.	117
Niles-Bement-Pond Co.	88, 90, 123, 124, 125 and 126
Nolte Brass Co.	92
Northern Electrical Mfg. Co.	106
Northern Engineering Works,	112
Norton Emery Wheel Co.	93
Nuttall Co., R. D.	96
Nutter, Barnes & Co.	121
Obermayer Co., S.	121
O. K. Tool Holder Co.	87
Olds Gasoline Engine Works.	120
Owen Machine Tool Co.	115
Parker Co., Chas.	110
Patterson, Gottfried & Hunter, Ltd.	114
Pattison Mchry. Co., W. M.	90
Pawling & Harnischfeger	112
Paxson Co., J. W.	112
Philadelphia Bourse	116
Philadelphia Gear Works	96
Phillips & Sons Co., F. R.	103
Phoenix Mfg. Co.	22
Phosphor Bronze Smelting Co., Ltd.	115
Poole Co., J. Morton	98
Potter & Johnston Mach. Co.	81
Pratt Chuck Co.	95
Pratt Institute	26
Pratt & Whitney Co.	2 and 3
Prentiss Tool & Supply Co.	88
Pryibil, P.	113
Queen City Mach. Tool Co.	104
Rand Drill Co.	26
Ransom Mfg. Co.	86
Reece Co., E. F.	92
Reed Mfg. Co.	110
Reeves Pulley Co.	112
Reichheim & Co., E. P.	4th Cover
Reliance Machine & Tool Co.	115
Rich, J. & G.	100
Ridgway Dynamo & Engine Co.	109
Rivett-Dock Co.	3d Cover
Rivett Lathe	3d Cover
Robbins, L.	102
Rogers, Boat, Gage & Drill Works, John M.	111
Rotary File & Machine Co.	110
Roth Bros.	108
Rowbottom Machine Co.	93
Royersford Fdry. & Mach. Co.	85
Safety Emery Wheel Co.	115
Saunders' Sons, D.	115
Sawyer Gear Works	96
Schieren & Co., Chas. A.	99
Schumacher & Boye	9
Schwerdtle Stamp Co.	90
Scranton & Co.	98
Sebastian Lathe Co.	92
Sellers & Co., Inc., William	34
Seneca Falls Mfg. Co.	103
Shepard Lathe Co.	113
Shultz Belting Co.	115
Sibley Machine Tool Co.	113
Silk Machine Tool Co., P. P.	98
Simonds Mfg. Co.	98
Simplex Time Recorder Co.	16
Skinner Chuck Co.	94
Slocomb Co., J. T.	20
Smith & Mills	85
Speed Changing Pulley Co.	29
Sprague Electric Co.	106
Springfield Machine Tool Co.	105
Standard Connecting Rod Co.	120
Standard Engineering Works.	113
Standard Gauge Steel Co.	98
Standard Tool Co.	24
Stanley G. I. Elec. Mfg. Co.	109
Stark Tool Co.	110
Starrett Co., L. S.	83
Stevens, F. B.	121
Stoever Fdry. & Mfg. Co.	85
Straley & Hasbrouck	85
Struthers-Wells Co.	120
Sturtevant Co., B. F.	13
Syracuse Raw Hide Co.	98
Tabor Mfg. Co.	116
Taylor-Wilson Mfg. Co.	96
Thompson, Hugh L.	85
Three Rivers Tool Co.	14
Tindel-Morris Co.	114
Toomey, Frank	88
Triumph Electric Co.	108
Trump Brothers Machine Co.	94
Underwood & Co., H. B.	116
Union Drawn Steel Co.	102
Union Twist Drill Co.	79
U. S. Foundry & Sales Co.	102
Vandyck Churchill Co.	19
Vickers, Sons & Maxim	103
Vitrified Wheel Co.	93
Wallace Supply Co.	121
Ward & Sons, Edgar T.	102
Warner Instrument Co.	101
Warner & Swasey Co.	75
Waterbury Farrel Foundry & Mach. Co.	118
Watson-Stillman Co.	117
Webster & Perks Tool Co.	87
Wellman Sole Cutting Mach. Co.	103
Wells Bros. Co.	31
West Haven Mfg. Co.	4th Cover
Westinghouse Elec. & Mfg. Co.	107
Westmacott Co., J. M.	113
Whatley, A. H.	92
Whitcomb-Blaisdell Machine Tool Co.	21
Whitman & Barnes Mfg. Co.	101
Whitney Mfg. Co.	71
Whiton Mach. Co., D. E.	94
Wiley & Russell Mfg. Co.	117
Wiley & Sons, John	34
Williams & Co., J. H.	92
Wilmarth & Morman Co.	95
Windsor Machine Co.	102
Wood's Sons, T. B.	121
Woodward & Powell Planer Co.	115
Worcester Mach. Screw Co.	30
Wormer Machinery Co., C. C.	89
Wyman & Gordon	4th Cover
Yale & Towne Mfg. Co.	90

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
Carborundum Co., Niagara Falls, N. Y.
National Corundum Wheel Co., Buffalo, N. Y.
Norton Emery Wheel Co., Worcester, Mass.
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Ingersoll-Sergeant Drill Co., New York.

Arbor Presses

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Bartlett, E. E., Boston, Mass.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Ball Bearings

See Roller Bearings.

Band Saws, Metal

Greaves, Klusman & Co., Cin., O.
Niles-Bement-Pond Co., New York.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
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Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Hill Pub. Co., New York.
Wiley & Sons, Jno., New York.

Boosters

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Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal

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Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Provl., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
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Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Draper Mach. Tool Co., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring and Turning Mills

American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
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Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
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King Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
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Carborundum

See Grinding Wheels.

Castings, Brass

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Castings, Steel

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Cement, Cast Steel

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Centering Machines

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Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
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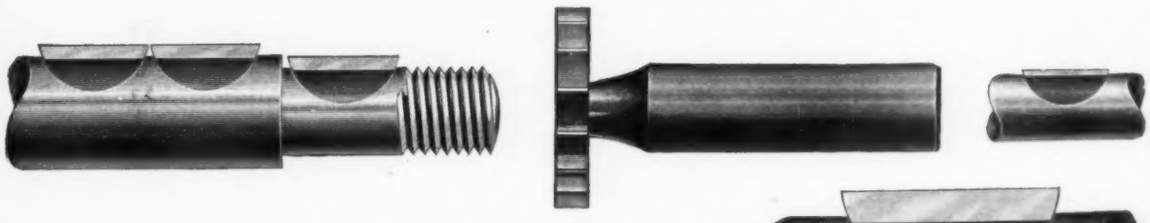

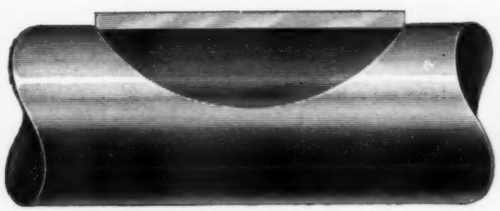

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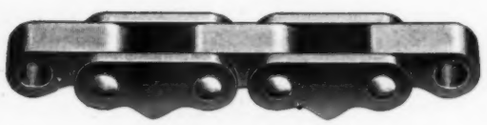

have been adopted by most of the leading manufacturers of

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Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chucking Machines

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Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Lathe

Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
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Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
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Niles-Bement-Pond Co., New York.
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Chucks, Split

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Clutches, Friction

Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Faneuil Watch Tool Co., Boston, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical

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Coils

Standard Welding Co., Cleve., O.

Compound, Pipe Joint

Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air

Blaisdell Mchy. Co., Bradford, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.

Compressors, Air—*Continued*

General Pneumatic Tool Co., Montour Falls, N. Y.
Herron & Bury Mfg. Co., Erie, Pa.
Ingersoll-Sergeant Drill Co., New York.
International Steam Pump Co., New York.
Rand Drill Co., New York.

Cones, Friction

Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps

Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Boston, Mass.

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General Elec. Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools

See Schools, Correspondence.

Counterbores

Slocomb Co., J. T., Provi., R. I.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.

Countershafts, Friction

Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels

Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis Mach. Co., W. P., Rochester, N. Y.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes

Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chambersburg Engineering Co., Chambersburg, Pa.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Jos., Jersey City, N. J.

Cupolas, and Ladles, Foundry

Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cut Meters

Warner Instrument Co., Beloit, Wis.

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Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

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Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Mach. Co., W. P., Rochester, N. Y.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Vandyck Churchill Co., New York.

Cutting-off Tools

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Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

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Dickinson, Thos. L., New York.

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American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

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Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
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Swaine Co., Fred J., St. Louis, Mo.

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Alteneder & Sons, Theo., Philadelphia, Pa.
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Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

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American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Niles-Bement-Pond Co., New York.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.

Drilling Machines, Multiple Spindle—*Continued*

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Flather Planer Co., Mark, Nashua, N. H.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

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Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mch. Co., Cincin., O.
Niles-Bement-Pond Co., New York.

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Baush Mach. Tool Co., Springfield, Mass.
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Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
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Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

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Niles-Bement-Pond Co., New York.

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Baker Bros., Toledo, O.
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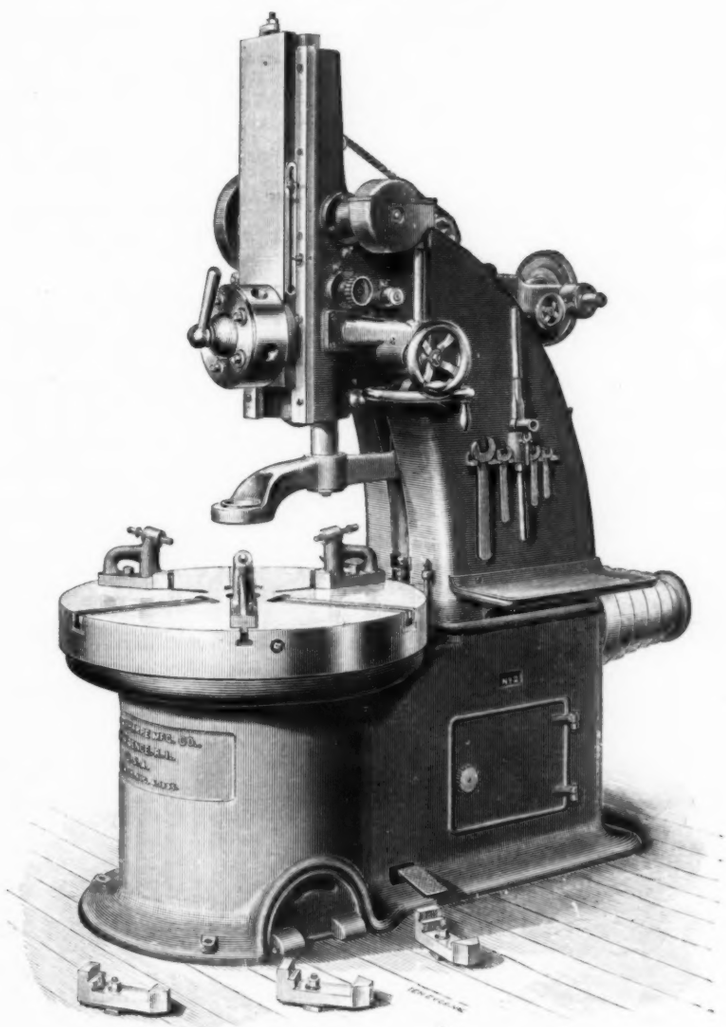

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Foos Gas Engine Co., Springfield, Ohio.
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Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

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Struthers-Wells Co., Warren, Pa.
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Gorton Mach. Co., Geo., Racine, Wis.

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Philadelphia Bourse, Phila., Pa.

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Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Buffalo Forge Co., Buffalo, N. Y.
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Crescent Forgings Co., Oakmont, Pa.
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Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
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Crescent Forgings Co., Oakmont, Pa.
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Eberhardt Bros. Mach. Co., Newark, N. J.
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Nuttall Co., R. D., Pittsburg, Pa.
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Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cincin., O.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
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Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
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Nuttall Co., R. D., Pittsburg, Pa.
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Albro-Clem Elevator Co., Philadelphia, Pa.
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Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
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American Gas Furnace Co., New York.

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Niles-Bement-Pond Co., New York.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
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Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

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Iroquois Mach. Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.

Grinders, Drill
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Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Portable
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Hisey-Wolf Mach. Co., Cincin., O.

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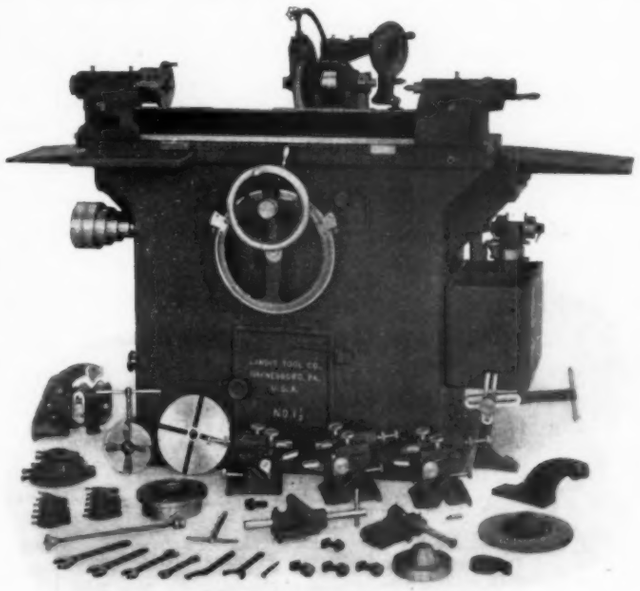

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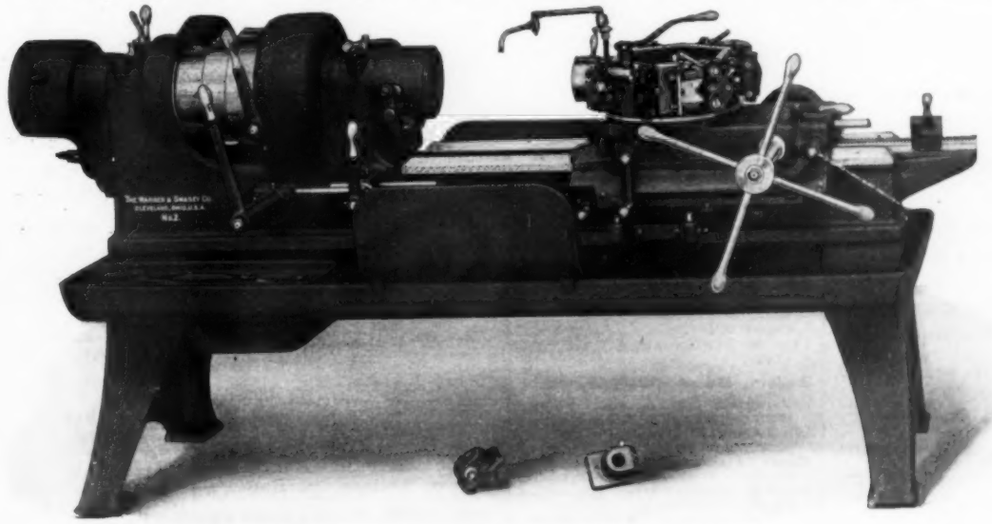

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Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
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Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
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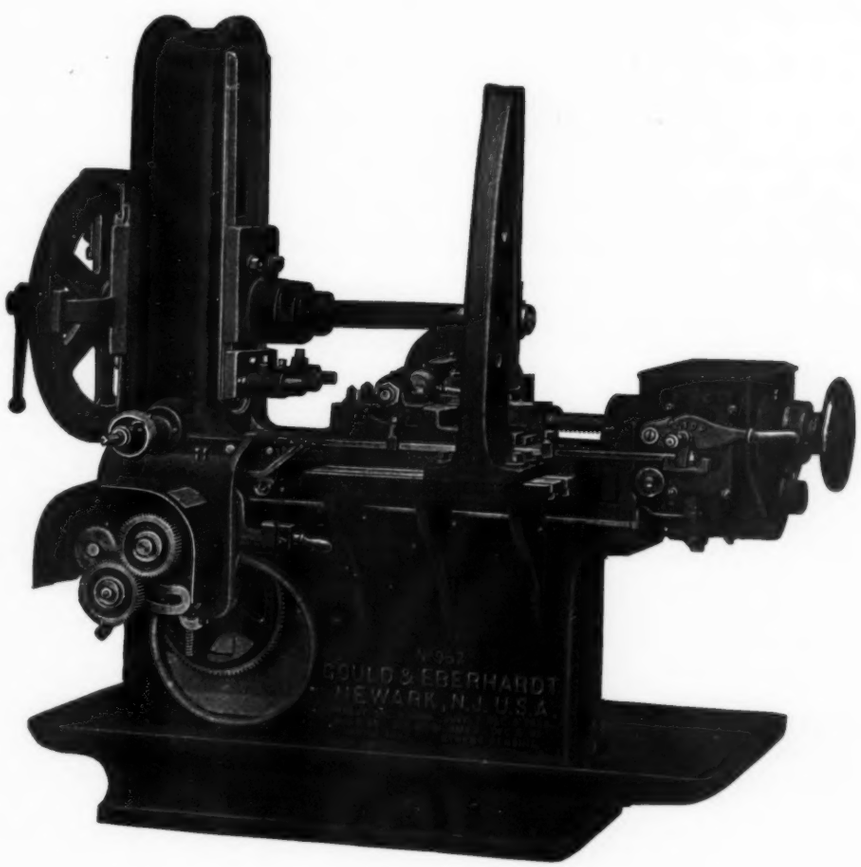

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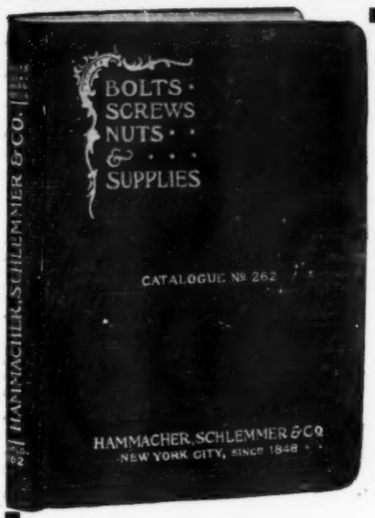

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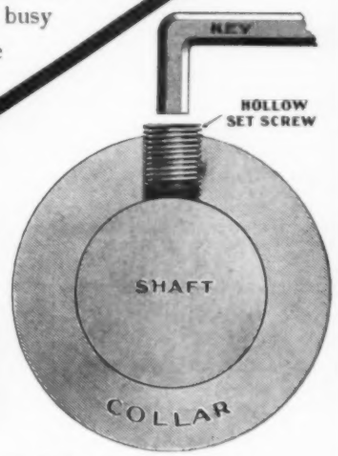

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New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

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Elmes Engineering Works, Chas. F., Chicago, Ill.
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Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

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Gould & Eberhardt, Newark, N. J.
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Massey Mach. Co., Watertown, N. Y.
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Gilmore Electric Co., South Boston, Mass.

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Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
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Riveters, Pneumatic
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Ingersoll-Sergeant Drill Co., New York.
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Chambersburg Engineering Co., Chambersburg, Pa.

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Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Standard Roller Bearing Co., Philadelphia, Pa.

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Dill Machine Works, T. C., Philadelphia, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Waterbury Farrel Fdry. & Mach. Co, Waterbury, Conn.

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Athol Machine Co., Athol, Mass.
Hammacher, Schlemmer & Co., New York.
Lucas, J. L., Bridgeport, Conn.
Sawyer Tool Mfg. Co., Fitchburg, Mass.
Slocomb Co., J. T., Provi., R. I.
Starrett Co., L. S., Athol, Mass.

Safety Valves, Pop
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.

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Drucklieb, C., New York.
Paxson Co., J. W., Philadel., Pa.

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Obermayer Co., S., Cincin., O.

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Nutter, Barnes & Co, Boston,, Mass.

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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Cochrane-Bly Co., Rochester, N. Y.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Nutter, Barnes & Co., Boston, Mass.
Tabor Mfg. Co., Phila., Pa.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
West Haven Mfg. Co., New Haven, Conn.

Sawing Machines, Wood
Colburn Mach. Tool Co., Franklin, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

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International Correspon. Schools, Scranton, Pa.

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Pratt Institute, Brooklyn, N. Y.

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Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Hartford Mach. Screw Co., Hartford, Conn.
National-Acme Mfg. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Windsor Mach. Co., Windsor, Vt.

Screw Machines, Hand
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Draper Mach. Tool Co., Worcester, Mass.
Garvin Mach. Co., New York.
Hartford Mach. Screw Co., Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

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Cook Co., Asa S., Hartford, Ct.
Hammacher, Schlemmer & Co., New York.

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Card Mfg. Co., S. W., Mansfield, Mass.
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Hart Mfg. Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
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National-Acme Mfg. Co., Cleveland, O.
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Garvin Mch. Co., New York.
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McDowell, Stocker & Co., Chicago, Ill.
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Motch & Merryweather Co., Cleveland, O.
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Niles-Bement-Pond Co., New York.
Pattison Mchry. Co., W. M., Cleveland, O.
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Tuohy Bros., New York.
Wickes Bros., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

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Cresson Co., Geo. V., Phila., Pa.

Separators, Oil and Steam
Nicholson & Co., W. H., Wilkesbarre, Pa.

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Cumberland Steel Co., Cumberland, Md.
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Pryibil, P., New York.
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Hendey Mch. Co., Torrington, Ct.
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Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
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Long & Allstatter Co., Hamilton, Ohio.
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Niles-Bement-Pond Co., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Vandyck Churchill Co., New York.

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General Mfg. Co., New York.
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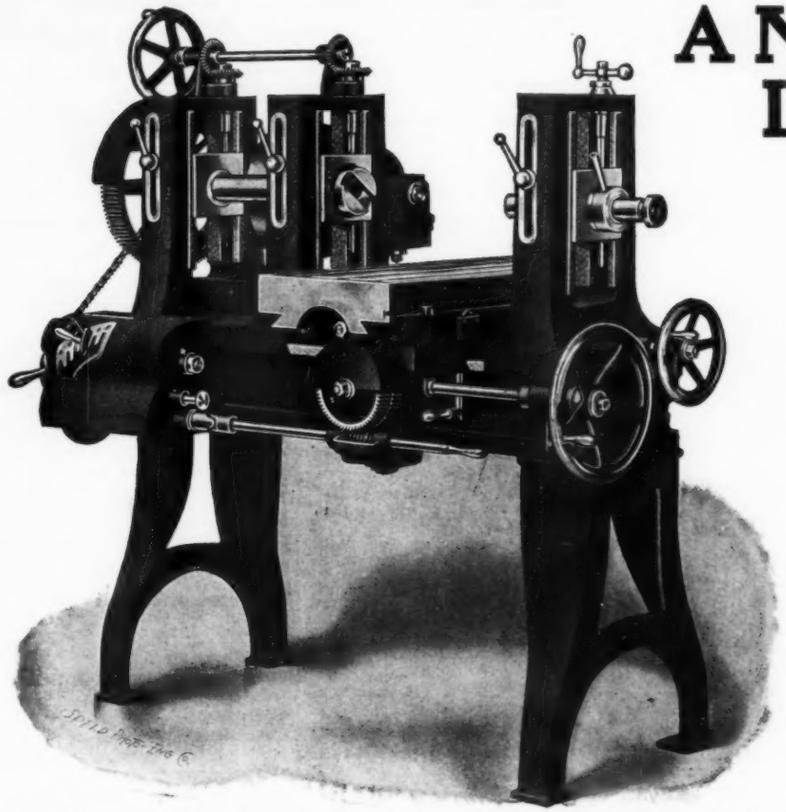

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that interests manufacturers of drop-forged wrenches, guns, and those generally who have need for a machine heavier and stiffer than the regular pattern Lincoln. Has solid boxes with taper bearing for spindle at either end Has overhead elevation for spindle, and dials reading to thousandths on elevating shaft and raising screw for tail block. Has tie bolts passing through slots in uprights and tops of boxes for rigidly binding heads together after desired setting of spindles has been made. Has positive chain drive for feeds with 12 changes in gear box from .006 to .062 per rev. of spindle. Feeds may be reversed to run table in either direction. Head and tail blocks gibbed and locked in permanent alignment to the bed. All feed work connection to table carried on outside, necessitating no openings in side and top of bed to reach table feed screw. Send for descriptive circular.

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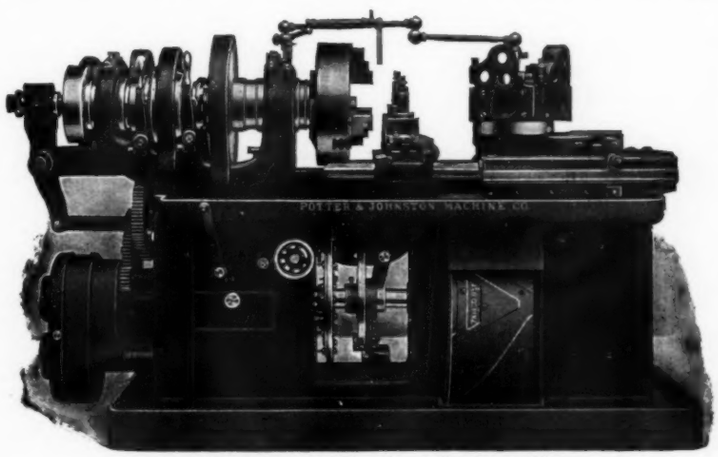

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See Steam Specialties.

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Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Athol Machine Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Hawkeye Wrench Co., Marshalltown, Iowa.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.
Hawkeye Wrench Co., Marshalltown, Iowa.

Methods of a New England Milling Machine Establishment.

The accompanying half-tones and line engravings illustrate a few of the special tools and methods used at the works of the Becker-Brainard Milling Machine Company, at Hyde Park, Mass.

BORING MACHINE FOR MILLER COLUMNS.

The fixture in Fig. 1 might well be called a mutiple-spindle boring machine, for it is a complete machine in itself and carries six spindles for boring as many holes in the columns of their Nos. 2 and 3 horizontal millers, these holes including the one for the overhanging arm, the seats for the spindle boxes, the bearings for the back-gear shaft and three holes further down on the column.

The column already machined on the face is slid into a seat in the base of the machine, and there clamped in the position indicated. Guide bushings are provided above and below the work, and where it is necessary to open out the holes with a drill prior to the boring operation, special drills are employed, whose bodies are ground to fit the upper bushings. The drive for the spindles is transmitted through back gearing by a belt running on a three-step cone pulley, the driving shaft and spindles being connected by spiral gears; and the feed is through differential spiral gears, the upper ends of the bars or spindles being splined and threaded, and the feed gear on each having an internal thread to form a feed nut. A pair of handles at the front of the head control the gear brackets, so that any one bar or the entire group may be slid up and out of action at will, the counterweights attached making this an easy matter.

The column to be bored is handled by a chain hoist attached to a trolley running on an overhead rail, and is readily slid into or out of its seat in the boring rig. The seat is practically a duplicate of that on the regular miller knee, and is arranged to receive either size of column. The guide bushings are located in eccentric sleeves, which may be turned in their seats and accurately secured in two different positions, thus taking care of the different center distances in the two sizes of columns bored in this machine.

After the boring operation, reamers with shanks fitting the guide bushings are used, and on a bench at the side of the machine are partitioned tool cases where these reamer-bars, with the double-ended cutters, drills, gages, etc., for each size of column are kept by themselves.

JIG FOR MILLER KNEES.

In Figs. 2, 3 and 4 is shown a type of jig which is used for drilling, boring and reaming the various holes in milling-machine knees. The one illustrated jigs the knee for their No. 4 horizontal miller, and an inspection of the engravings will show that it is quite a sizable affair, its height being about 3½ feet and its weight not much under 4,500 pounds.

The top is lifted off bodily by a crane and the knee already finished on its bearing surfaces is slid into place in a seat with edges dovetailed 45° and corresponding to the face of the miller columns. Here the work is clamped by a gib operated by the three handles seen in Fig. 3 at the back of the jig, and is thus secured in precisely the way in which it will later be held to its column. The jig cap when dropped back on its seat is located by dowels and secured by swinging hook clamps at either side, the studs on which these are pivoted being formed with eccentric bodies so that a slight turn of the handles is sufficient to secure the cap for the subsequent operations.

The jig takes care of sixteen holes, in fact every hole in the knee with the exception of those for oil, all the important ones being bored nearly to size and then finished with rose reamers. The seat for the knee, the clamp gib and the position of the holes for the bushings for boring bars and drills are all shown in the line drawing. The bushings, however, are not represented in place in the engraving, and, as will be seen from the photographs, a few slight modifications have been made in the jig construction since the blueprint here reproduced was made.

VERTICAL MILLING-MACHINE WORK.

They make wide use of the vertical miller at this shop and among the jobs regularly handled on this type of machine are a number that ordinarily would be considered as coming under the head of lathe work. With the aid of the rotary milling attachment cylindrical parts are finished outside and in with a degree of accuracy that permits entering and receiving parts to be scraped and fitted together with the same facility as if turned and bored, and the machining is done at what is stated to be a considerable saving of time over former records in the lathe.

Some interesting examples of this class of work are found in connection with the manufacture of the rotary attachment itself, a section through the center of which

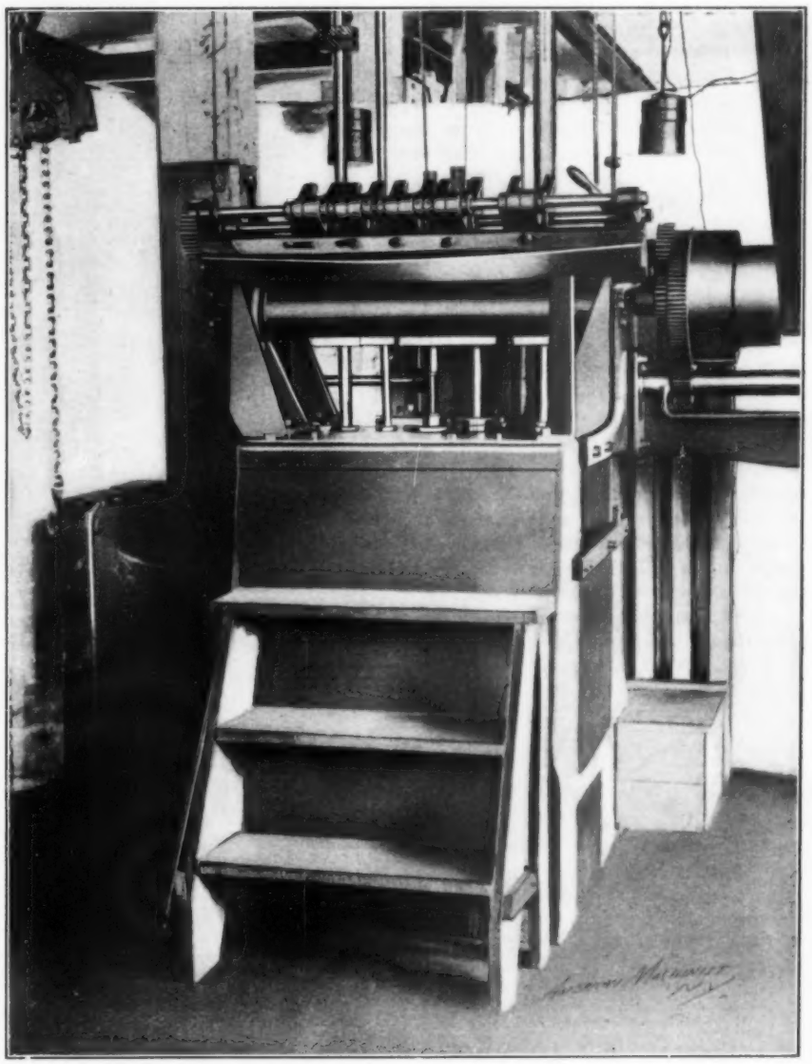


FIG. 1. BORING MACHINE FOR MILLER COLUMNS.

is given in Fig. 5. With one or two exceptions the various surfaces are finished on the vertical miller, the different outside and inside bearing surfaces all being milled to standard gages. The conical surfaces on the gib ring *A* and the rotating member *B* are milled with the same cutter, which is of course ground to the correct angle, and little work is required to bring the ring to the proper bearing after it leaves the miller.

In machining the gib ring, the first operation is the milling out of the bore, after which the piece may be located for the following operation by dropping it over a centering disk, which has a plug fitting a hole in the center of the rotary work table. The work is bottom side up during the milling of the angular edge, with the small end of the cutter down, or in the same position as when milling out the conical seat in casting *B*. The latter is in the form of a worm wheel to rotate the table and the outside is milled to correct form and diameter by a formed end mill.

The various castings are, of course, put through in lots, and for each part so handled setting rings and disks are provided for locating the work on the rotary table, and stops are set so that after a roughing cut has been taken the miller table may be moved against a stop and held there while the cylindrical surface, whether external or internal, is being finished. High-speed cutters are used quite extensively on this work, as well as throughout the shop generally, and very little adjustment in the table setting is necessary to hold the work up to standard size.

Aside from the parts mentioned there are many other pieces, such as gear blanks, hand-wheels, etc., which are finished by circular milling,

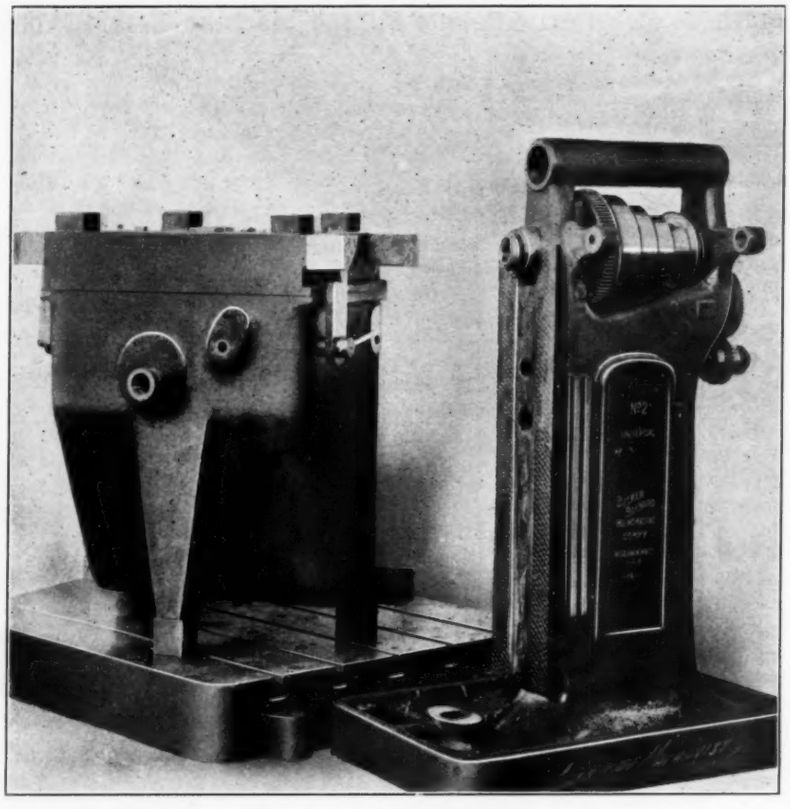


FIG. 2. JIG FOR MILLER KNEE.

GRADUATING IN THE LATHE.

For cutting the graduations in the periphery of the circular milling attachment, the arrangement illustrated in Fig. 6 is utilized. In this device the indexing of the lathe spindle, and hence of the work mounted on the face-plate, is accomplished by a worm mounted in a swinging bracket and adapted to engage with a worm wheel

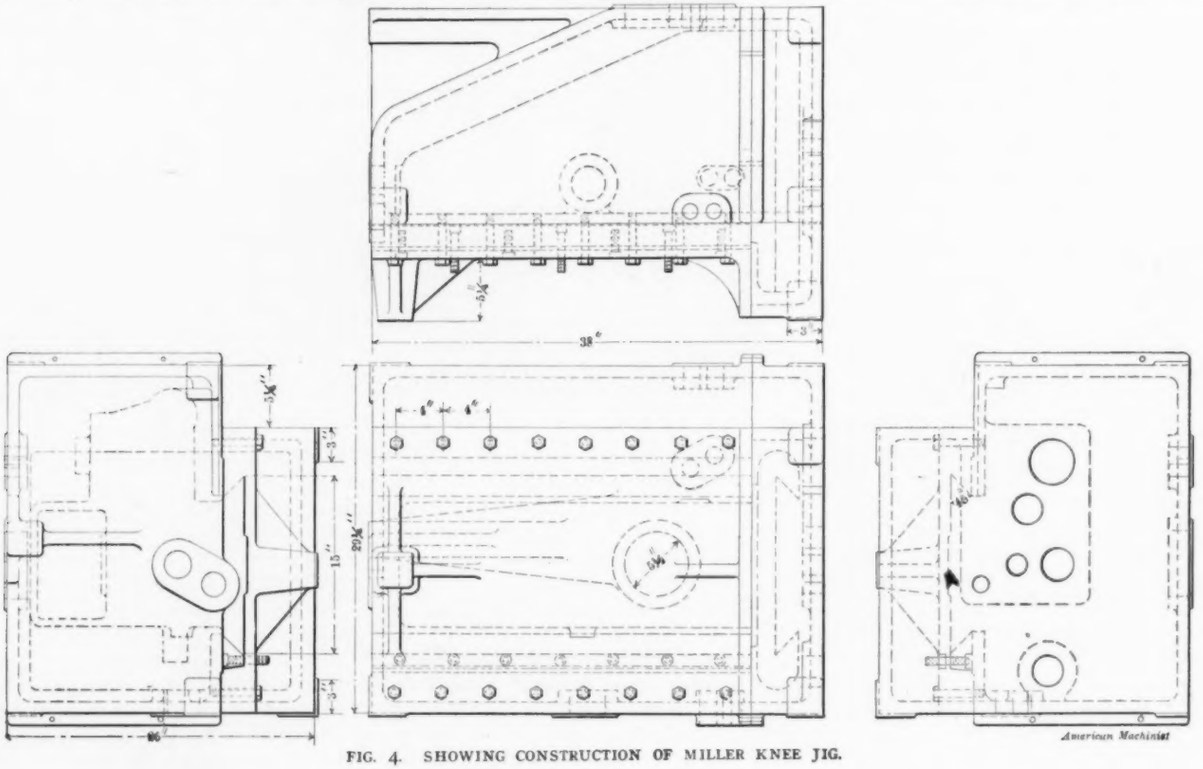


FIG. 4. SHOWING CONSTRUCTION OF MILLER KNEE JIG.

attached to the large spindle gear. The graduating tool is carried by a special slide located at the left-hand end of the carriage and reciprocated by a hand lever. The movement of the slide and cutter is limited by a stop working in connection with a disk, which has a series of notches whose depths correspond to the different lengths of lines desired. The disk rotates tooth by tooth as the tool slide is reciprocated, and the stop entering each notch on it comes into alinement and allows each line to be cut just to the required length.

Before the graduating operation is performed, a light cut is taken on the face of the table with a tool carried by the regular cross-slide. The carriage is then run back to a stop, the indexing worm swung into mesh with the worm wheel (the driving cone, of course, being free on the spindle), and the graduating tool, already located on the special cross-slide, brought into position. The method of mounting the worm bracket in its upright (which ordinarily is left on the lathe) and the locking mechanism for the indexing crank handle are clearly shown in the halftone.

MILLING THE HEADS FOR VERTICAL SPINDLE MACHINES.

An interesting example of milling is represented in Fig. 7, where, on a double spindle machine with a bed 19 feet long, a string of heads for the regular vertical millers are being machined. As will be observed, only one of the vertical spindles is used, as the width of the dovetail seat in the back of the head is not sufficient to allow a pair of cutters to work simultaneously. Convenient fixtures are employed for holding the work, and it is obvious, from the length of the bed, that a considerable number of heads may be machined at one setting.

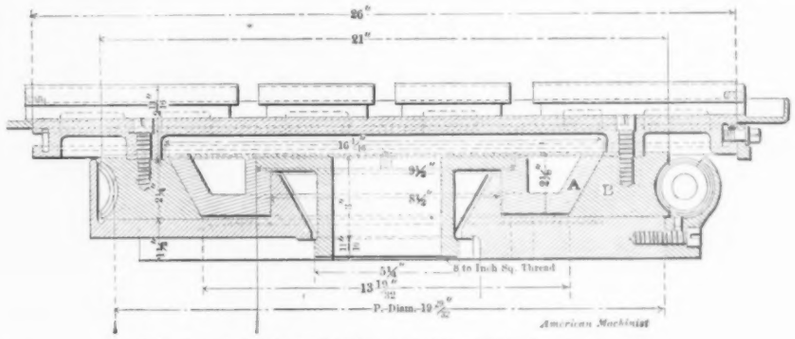


FIG. 5. SECTION THROUGH ROTARY MILLING ATTACHMENT.

MILLING WORMS.

In Fig. 8 is illustrated the way in which this concern mills worms on one of their universal machines. The cutter is carried by the vertical and angular milling attachment, and the worm blank mounted on an arbor carried by the dividing head which is connected to the table-feed screw by the necessary gears to give the desired lead.

As in most of this work of comparatively fine lead, the spiral head must be so geared up as to give its driving worm a high rate of speed as compared with that of the feed screw; no attempt is made to drive in the usual way from the screw to the head, but, instead, to reduce the strain upon the gearing the drive is taken first by the spiral head in the manner indicated and then transmitted back through the gearing to the feed screw, the telescopic shaft being carried by special brackets and driven through gearing from a shaft operated by the regular feed cones and belt.

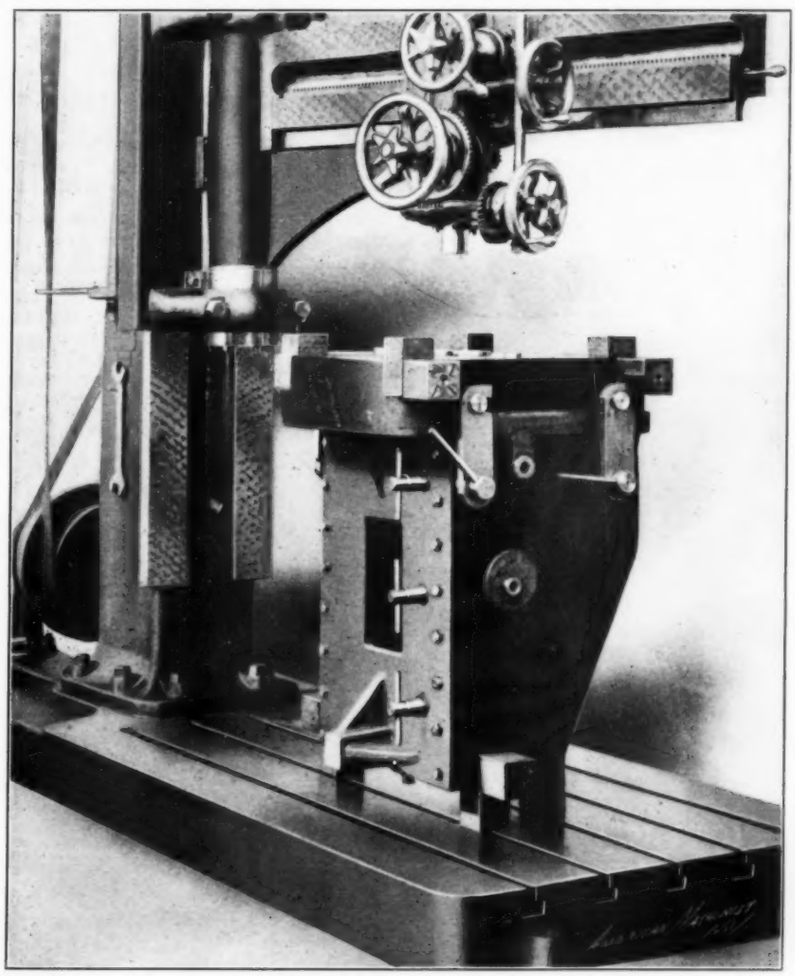


FIG. 3. MILLER KNEE JIG UNDER RADIAL DRILL.

AUTOMATIC MACHINE FOR DRILLING INDEX PLATES.

The machine in Fig. 9 is an 18-inch automatic gear cutter regularly made by the company, and in this instance arranged for automatically drilling index dials used on dividing heads, etc. A special head with a spindle for the drill is mounted at the front of the cutter slide and the latter is reciprocated to feed the drill in and out, and the work indexed the same as if a gear were being cut. Near the rear end of the spindle is a cylindrical case in which a helical spring is placed, and as the drill is advanced against the face of the work it receives first the pressure of the spring only, the dwell thus produced in the feed giving the drill an opportunity to start true and to enter to its full diameter before being acted upon by the positive feed.

The adjustments for different circles are made with the same facility as if setting for gear-cutting operations.

TURNING BACK-GEAR SHAFTS.

A lathe fitted up for turning the eccentric ends of back-gear shafts is illustrated in Fig. 10, the special attachment consist-

ing of a cap fitted to the spindle nose and carrying the inner end of a removable sleeve or holder for the work bushing.

This holder or chuck proper has an eccentric bore to give the work the required throw and runs in a bearing formed in a support which is fitted to the lathe ways, the casting attached to the spindle simply serving as a driver. The chuck interchanges with others having different degrees of eccentricity and the sleeves or bushings receiving the shafts are of various diameters of bores to suit different jobs. A driver in the chuck acts as a locator for the shaft so that the eccentric ends come in alinement, and the hinged cap forming the upper half of the box or bearing for the chuck facilitates the setting up and carrying on of operations.

F. A. S.

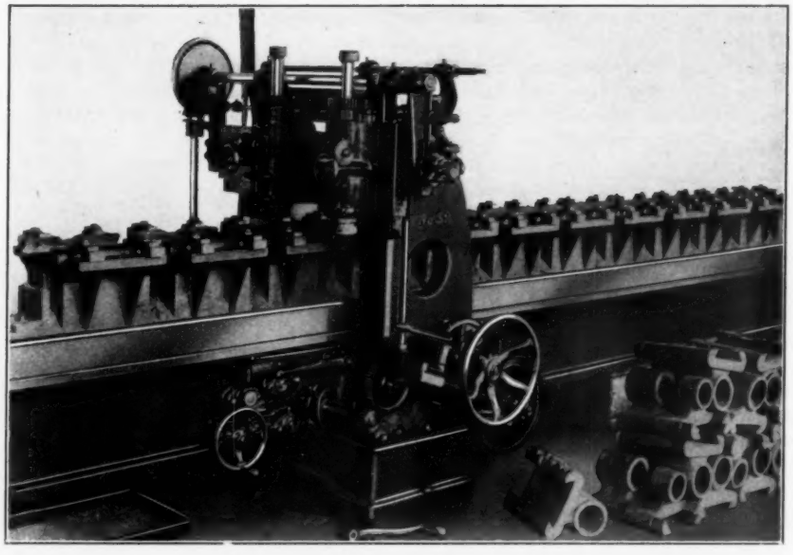


FIG. 7. MILLING VERTICAL SPINDLE HEADS.

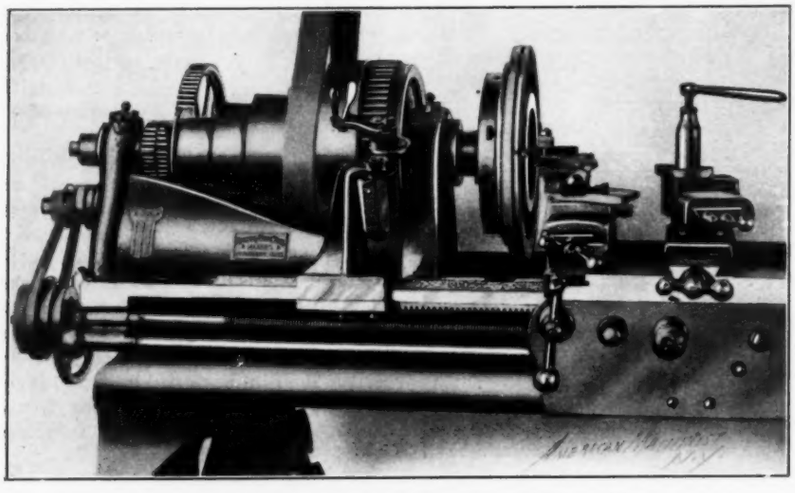


FIG. 6. A GRADUATING ATTACHMENT FOR THE LATHE.

Newspaper Railroading.

We have had sent to us a clipping of a "special" to a New York daily paper which recounts the following remarkable mechanical phenomenon, which somehow reminds us of Kipling:

"An engine in the roundhouse at Montclair became restless shortly before last midnight, and without the assistance of a fireman got up steam enough to start it going. It drove a much larger engine off the tracks into the deep turntable pit."

It would be interesting to know just what was the reporter's conception of the meaning of the phrase "getting up steam." If this alleged incident occurred in the book of some famous author we should say it was "poetic license" run wild; as the babbling of a four-year-old child it would have been amusing; but presented as it is with all the appearances of a serious news item, it has a tendency to discredit the accuracy of "special dispatches." One would think that it didn't need much familiarity with a locomotive to know that no matter how high the steam pressure rose, it would not have caused the engine to start by itself, that having necessarily been occasioned by a derangement of which the dispatch makes no mention.

Manganese in Gray Iron.

In a paper read before the Atlantic City meeting of the American Society of Civil Engineers, H. Souther describes a case of trouble from hard castings of a somewhat unusual character. In one case the castings were being drilled on a multiple drilling machine. The small drills, ¼ inch or so in diameter, were standing up well, but the ½-inch and ¾-inch drills were rapidly getting dull, just as if the iron were charged with emery. Chemical analysis showed the composition to be normal, with the exception of the manganese, the composition being silicon, 2.50; phosphorus, 0.70; sulphur, about 0.080; total carbon, 3.50; manganese, 0.16. The frac-

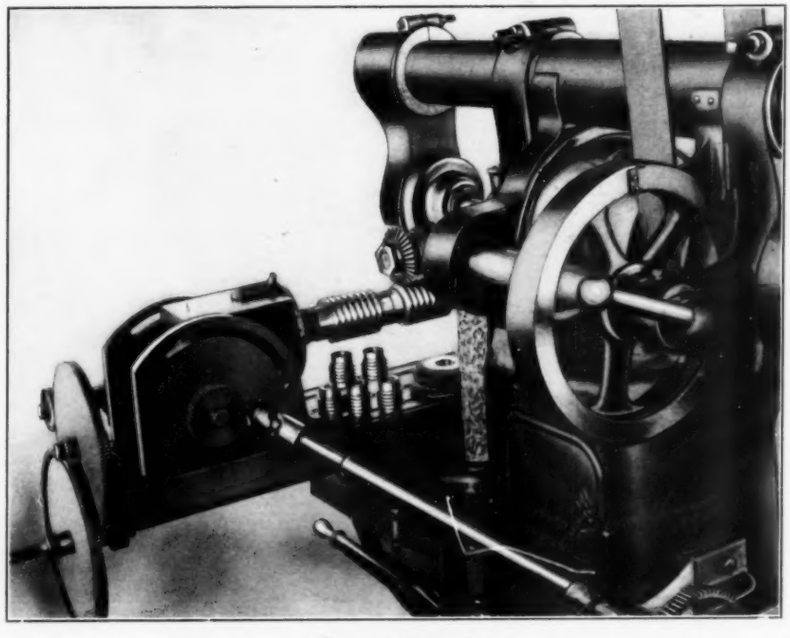


FIG. 8. MLLLING WORMS.

ture of the iron was good, and microscopic examination showed nothing abnormal. As the only thing out of the ordinary appeared to be the percentage of manganese present, it was determined to increase it to 0.50 per cent, and as soon as this was done the trouble disappeared. Mr. Souther states that, during the last five years, three similar cases have been brought to his notice.—*Engineering.*

Producing High Vacua.

The German scientific journal *Prometheus* states that the English physicist Dewar has found a new process for obtaining high vacua, which forms another practical employment of liquid air. It is known already that charcoal possesses the property in a high degree of absorbing gases. Dewar has demonstrated that this absorptive property of charcoal increases manifold if it is cooled to the temperature of liquid air. The absorption takes place so energetically that if the charcoal is contained in a closed vessel the latter soon becomes void of air.

Where formerly the quicksilver pump had to be worked incessantly for hours and days, it now suffices to attach a tube to the vessel intended to be freed of air, into which some charcoal, preferably of cocoanut shell, is placed, which has been immersed in liquid air. In this manner a vacuum is obtained within a few minutes suitable for producing cathode or X-rays. This method possesses also the advantage that the moisture, which can sometimes be only removed with difficulty from the vessel, is at once condensed in the tube.

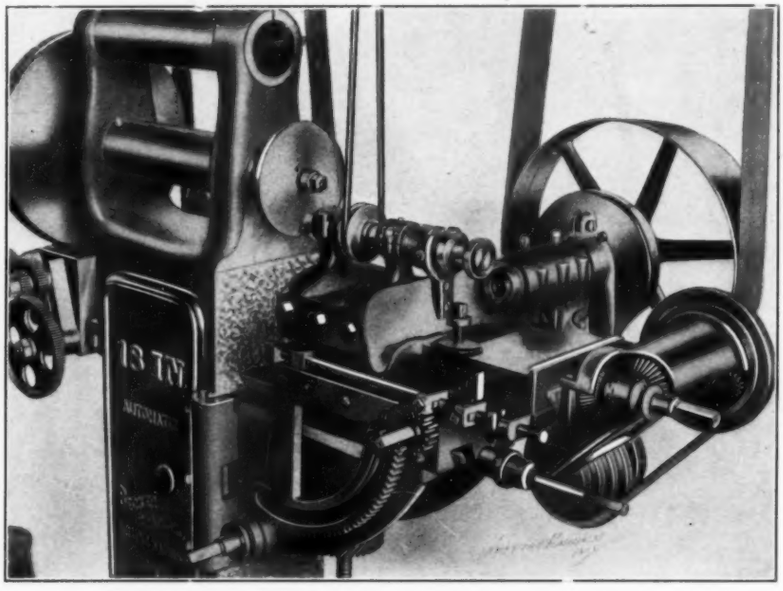


FIG. 9. AN AUTOMATIC GEAR CUTTER ARRANGED FOR DRILLING INDEX DIALS.

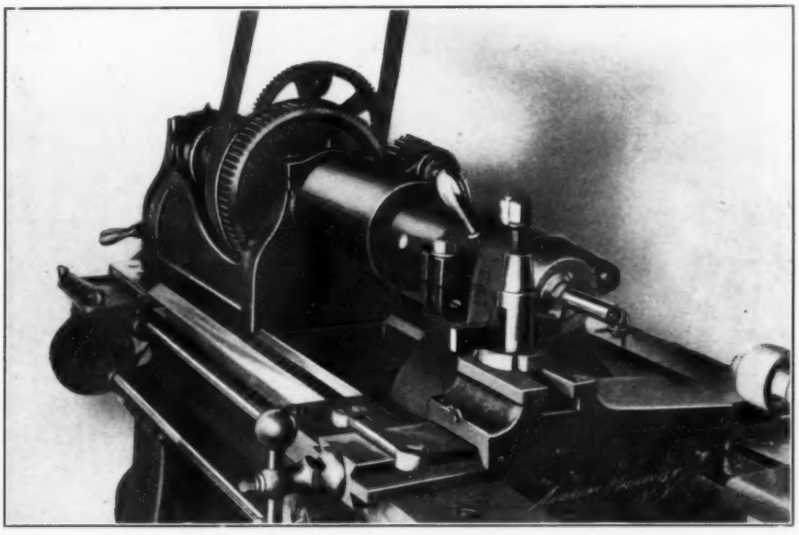


FIG. 10. CHUCK FOR TURNING ECCENTRIC ENDS OF SHAFTS.

A Peculiar Break of a Bar of Steel.

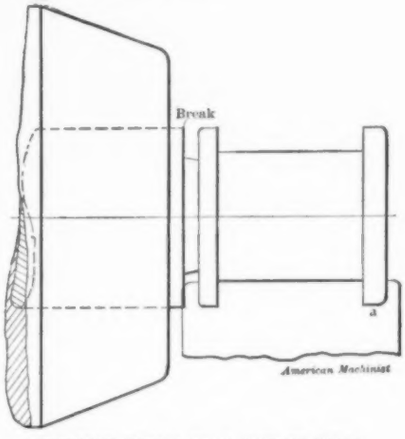
J. P. Brophy, vice-president and general superintendent of the Cleveland (Ohio) Automatic Machine Company, sends us a piece of steel shown (half size) in the accompanying illustration, and writes us about it as follows:

"This bar is about 10 points carbon. What we would like to ask you is, can you figure out why this piece broke away from the bar by reason of nothing but the action of a cut-off tool? It is something that never happened to us before.

"The blueprint shows in about what position this was held in the chuck while being cut off. It was very rigid, with very little overhang, and the peculiar part of it is that it broke in the largest diameter in the neck where we show the cut-off.

"It cannot be possible that the action of the forming tool would strain this bar to such an extent that it would fracture it in this way, because if that were the case it would unquestionably have broken off before the cut-off tool commenced to do its work.

"The resistance of this cut-off tool is very slight, and you will notice that the chip we were removing is only a few thousandths inch thick.



PECULIAR BREAK OF A BAR OF STEEL.

"It makes no difference what kind of steel it might be, we cannot understand how it would break in this way. Perhaps you can offer some solution of this peculiar break.

"Bear in mind that the forming tool reaches down on the two sides about to the dotted line, which shows that the cut-off tool had just commenced to do its work.

"We are mystified as to why it has occurred, and as you are interested in problems of this kind, we would like to have you give us your opinion, and if you cannot understand why this has happened, perhaps some of your readers could solve the problem."

[Though the shoulder farthest from the break looks as though something had rubbed against it as it turned (the corner *a* is slightly upset or spun over) and the

bar shows some piping at the center and a fracture indicating a steel of no very great strength, there is nothing in the case, so far as we can see at all, sufficient to account for this break at the point indicated, where the bar is slightly more than 1⅜ inches diameter.—ED.]

A New Method of Driving Floor Boring Machines.

The accompanying illustrations show a new method of driving machines of the floor boring type which has been applied to these machines by Wm. Sellers & Co., and which is of decided interest.

Machines of this type have usually been driven from the end of the bed, transmitting the power through long shafts in the bed and upright. The distance between the power and the work is so great that the transmitting shafts must be heavy to avoid undue torsional deflection and in any case the power absorbed in the transmitting gearing is excessive.

The method shown is an obvious outgrowth of the use of an electric motor, which, being mounted on the upright of the machine, makes the arrangement feasible. The belt will be seen to pass around several pulleys in succession, each of which is connected to some driven member except the one in the near foreground of Fig. 1, which is a tightening pulley only.

Tracing the belt upward from the tightening pulley, it will be seen to embrace first the driving pulley *a*, Fig. 2, for the main spindle, above this at the top of the column, *b*, for the vertical movement of the head and at the base of the column, *c*, for the horizontal movement of the column. Alongside the upright at *d* is a vertical square shaft which is rotated by a pair of miter wheels carried on the head, through a separate feed motion, provided

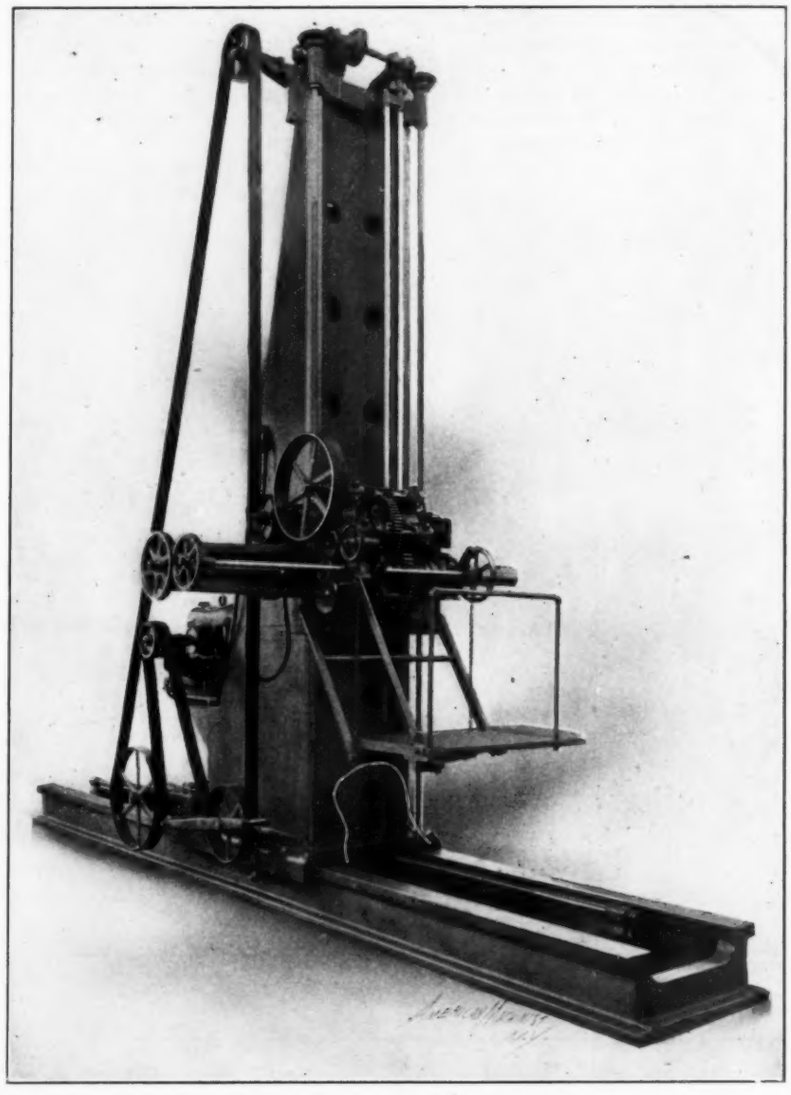


FIG. 1. A NEW FLOOR-BORING MACHINE.

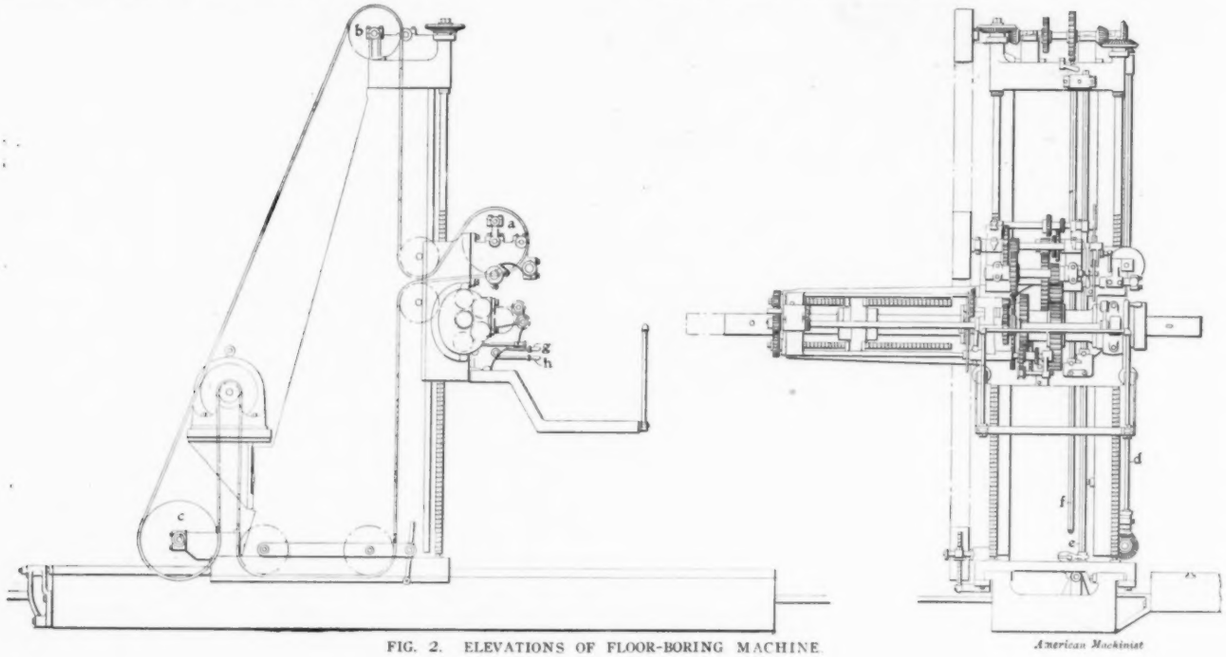


FIG. 2. ELEVATIONS OF FLOOR-BORING MACHINE.

with its own friction disks for varying the feed and having two ratios of gearing operated by a clutch on the head so as to give a very wide range of milling feeds. These milling feeds are taken from the shaft of the receiving pulley *a* on the head and thus are independent of the rotation of the boring spindle, except in so far as all the speeds are changed by varying the speed of the motor. The vertical shaft *d* is connected by gearing on the top with the lifting screws for the head, and by a suitable train at the bottom with the rotating nut of the stationary screw in the bed. It is therefore used to drive both the vertical and the horizontal milling feeds. Two square shafts *e f* on the front of the machine operate clutches, *e* operating clutches at the base of the upright by which either the rapid traverse from pulley *c* or the milling feed from shaft *d* is engaged, according to the position in which the clutch is set, and *f* operating clutches at the top by which the rapid traverse from pulley *b* or the milling feed from shaft *d* is engaged.

These two clutch shafts are controlled by levers *g h* on the head. The direction and speed of the rapid traverse is determined by the direction and speed of the motor, both of which are controlled by apparatus on the head. The direction of the horizontal and vertical feeds is governed by a clutch in the feed train, also on the moving head. The operator on the platform can therefore run the spindle into the desired position and then throw in either of the milling feeds or the boring feed, and change the amount of feed or its direction, as well as vary the speed of the spindle, without moving from his place on the working platform. The speed of the spindle is controlled by changing the ratio of gearing on the head and by varying the speed of the motor. The platform is attached to the head by two round projections entering holes near the lower edge, and it may be readily removed when the spindle is run into its lowest position, as it is only required when the head is too high to be easily reached from the floor.

As already stated, the horizontal movement is obtained by turning the nut instead of the screw, an arrangement which has a marked effect on the stiffness of the movement. With the opposite arrangement the deflection of the screw is at a minimum with the nut at the driven end and increases as the nut travels along it to a maximum with the nut at the other end, the stiffness in all positions of the nut being that of the part of the screw between the nut and the driving gear only. With the present arrangement the deflection is the same with the nut at either end of the screw, while in all positions the stiffness is the combined stiffness of both ends of the screw.

The diameter of the spindle of the machine shown is 6 inches and its traverse 6 feet. It has 60 changes of speed, ranging from 2 to 120 revolutions per minute. The boring and drilling feeds range between .0019 to .3 inch per revolution of the spindle, while the milling feeds range between 1 and 8 inches per minute. The traverse movements are at the rate of 8 feet per minute. Other sizes have spindles ranging from 4 to 10 inches diameter.

As an illustration of the range of capacity of these machines we give Fig. 3, which shows the face-plate of a boring mill recently constructed by the makers. The table is 16 feet 8 inches in diameter, the mill to which it belongs having a swing of 25 feet.

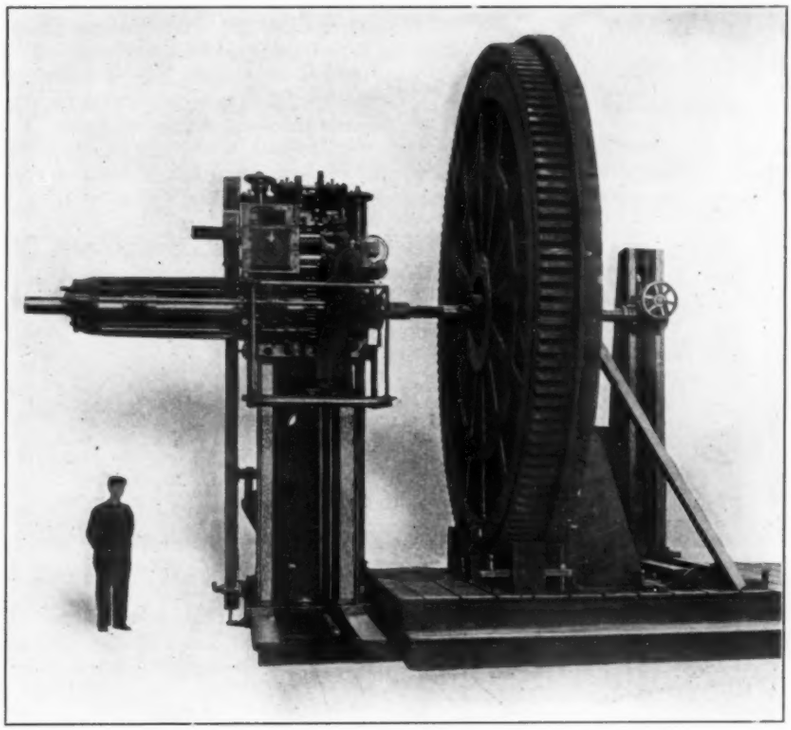


FIG. 3. A FLOOR-BORING MACHINE JOB.

The annual report of the Commissioner of Patents shows that for the twelve months ending June 30 the receipts of the office were $1,737,334, and the expenditures over a quarter of a million less, the surplus turned into the Treasury being $264,667. There were received during the fiscal year 52,323 applications for mechanical patents, 749 applications for designs, 174 applications for reissues, 1,846 caveats, 11,298 applications for trade-marks, 1,236 applications for labels and 448 applications for prints. There were 30,266 patents granted, including reissues and designs, and 1,426 trade-marks, 1,028 labels and 345 prints were registered. The number of patents that expired was 19,567. The number of allowed applications which were by operation of law forfeited for non-payment of the final fees was 5,154.

The advisory committee appointed by the various engineering societies to cooperate in the locomotive tests made by the Pennsylvania Railroad at the Louisiana Purchase Exposition has passed some extremely complimentary and equally well deserved resolutions commending the company for its extremely liberal action in undertaking the tests. The resolutions also mention by name the individuals who were chiefly instrumental in the conception and conduct of the tests and in the design of the apparatus. The tests are to be published in full, and the mass of information obtained will thus be made available by all interested parties.

By a recent vote of the American Society for Testing Materials the by-laws were amended, making membership in the International Association for Testing Materials independent of membership in the American Society. Members of the last-named society may now be also members of the international society or not, as they choose; those who hold such membership in the international society paying $1.50 per year addition to their dues in the American society, which last are $5 per year.

The *Times* correspondent at St. Petersburg states that the three battleships, "Andrei Pervosvanni," "Imperator Pavel" and "Ivan Zlatoust," cannot be completed because the engines are too big for the hulls. We do not understand this, of course, nor how such a thing could come about, and the temptation is to poke fun at the Russian navy. But then there is the "Bennington" tragedy to think about.

The New Plant of the B. F. Sturtevant Company at Hyde Park, Mass.

This recently completed plant is located on a tract of land containing about twenty acres and having a frontage of 1,300 feet along the freight-yard tracks of the New York, New Haven & Hartford Railroad, near its station at Readville, which is about ten miles out from Boston.

FIG. 1. THE WORKS OF THE B. F. STURTEVANT COMPANY, HYDE PARK, MASS.

A general view of the works, the architects of which were Lockwood, Greene & Co., of Boston, is given in Fig. 1, and a view during process of erection in Fig. 2. Fig. 3 is a plan giving the dimensions of the various buildings, and Fig. 4 shows some of the construction details of the machine shop, which is the central building of the group.

The walls of the different buildings are all of brick, and steel girders and columns enter into the construction of such buildings as are equipped with traveling cranes. The upper floors are of planks, with a top course of maple, laid on heavy wooden beams and designed, in the case of the principal buildings, for carrying safely loads of 200 to 250 pounds per square foot. The roofs are of heavy planks, covered with tar and gravel.

THE OFFICES.

The office building is a four-story structure, with the production and advertising departments on the first floor, the commercial offices on the second floor, the drawing offices on the floor above, and photographic and blueprint rooms on the upper floor. Fireproof vaults are built in for each floor, and in the basement is a lunchroom for the office force (numbering about 160 persons), a printing office and storerooms for office supplies, and the heating apparatus for the building.

THE POWER PLANT.

The power house is located at the opposite end of the grounds, and is equipped with two Sturtevant generating sets of 100 and 250 kilowatts, respectively, supplying current at 220 volts, for operating and lighting the works; a battery of four Stirling boilers, with under-feed stokers and Sturtevant fuel economizers; an air compressor, etc. The fire and service pumps are in a detached building at the rear.

FIG. 2. PLANT IN PROCESS OF ERECTION.

The Sturtevant system for heating and ventilating is used throughout the entire plant, and the distribution of steam utilized in this service, as well as the distribution of electric current, compressed air, etc., is through a tunnel connecting power house and shops.

THE MACHINE SHOP.

The foundry was fully illustrated in these columns at page 1561, Vol. 26; so we will pass at once to an inspection of the machine shop and some of its operations.

The building is 500 feet long by 120 feet wide, with 40-foot side galleries and a series of sawtooth lights running the full length of the roof and extending well out on the galleries, as shown by Figs. 1 and 4, so that with these and the side windows the building is well lighted at all points. A 10-ton electric crane, running on rails located at the sides of the galleries, as represented in the sectional view in Fig. 4, serves the main bay, and commodious electric elevators are provided at either end of the building for conveying material between the main and gallery floors.

The castings storage at the side of the shop is shown in Fig. 5; and interior views are presented in Figs. 6 to 14, inclusive, the first of these giving some idea of the length of the shop and showing the method of mounting the crane ways and the application of ceiling motors to the driving of the machinery in the galleries. Here, as in other branches of the works, everything is motor driven, the

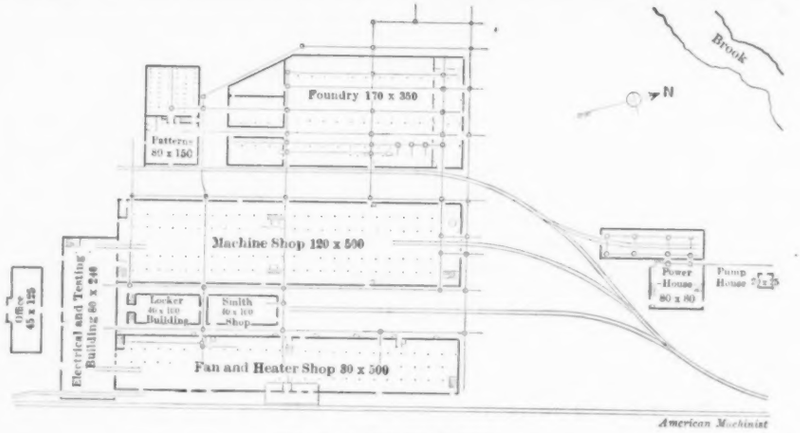

Brook
N
Foundry 170 x 350
Pattern 80 x 150
Machine Shop 120 x 500
Locker 80 x 100 Building
Smith 80 x 100 Shop
Office 45 x 125
Electrical and Testing Building 80 x 240
Fan and Heater Shop 80 x 500
Power House 80 x 80
Pump House
American Machinist

FIG. 3. PLAN OF WORKS.

lighter tools being usually operated in groups by motors of Sturtevant manufacture. A good many of the heavy tools are, of course, driven by independent motors.

Those who have been accustomed to thinking that the activities of this concern are confined principally to the building of blowers, exhaust fans, etc., will be undeceived by the photographs taken at various points about the machine shop. By far the greater part of the work done here is in connection with the construction of steam engines and electrical apparatus, for large lots of automatic cut-off and

Figs. 9, 10 and 11 are gallery illustrations, the first showing the tool-room and stores; the second a line of shapers, millers and light planers; the third the screw-machine department, with stock racks facing the line of flat turrets. Further down this side there is a group of Landis and Brown & Sharpe grinders, where pistons, cross-heads, crankshafts, disks and other parts of the lighter engines are finished. Practically all parts that can be handled in a grinder are finished in that way.

In the opposite gallery, of which Fig. 10 represents a section, there are, besides these enters one end of the machine shop, where material may be readily taken care of by the traveling crane. There is also a system of industrial railways connecting the machine shop with the other branches of the plant.

THE PATTERN BUILDING.

The pattern shop, flask shop and pattern storage occupy a building closely adjacent to the foundry, and a brief description of which was given in connection with the foundry article referred to above.

Fig. 15 is a view in the pattern room, and Fig. 16 shows a portion of the pattern storage. The building is divided mid-

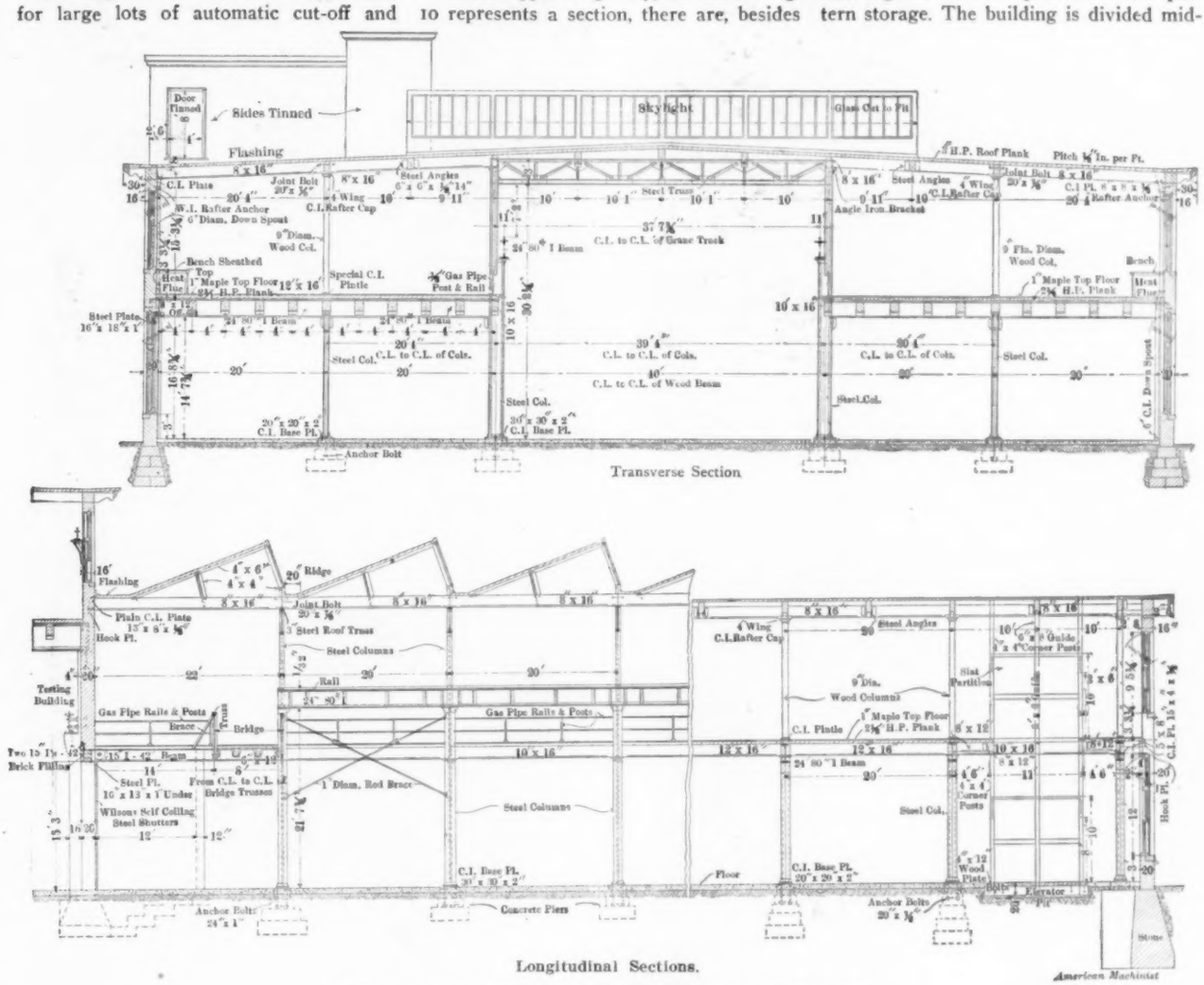


FIG. 4. SECTIONS SHOWING CONSTRUCTION OF MACHINE SHOP.

throttling engines, both upright and horizontal, are built, as well as motors and generators of various sizes, and complete generating sets. Another line of work is the manufacture of economizers, a large number of sections for which will be noted in the foreground of Fig. 6.

Aside from the heavy planers and other tools shown on the main floor there are a large number of boring mills, radial drills, upright drills, etc. A Landis grinder, taking about 12 feet between centers, is used for finishing heavy shafts, the lighter work all being ground on machines in the gallery.

the tools shown in that view, groups of Bullard vertical chucking machines, cutting-off machines, Becker-Brainard, Lincoln and other millers.

All parts are manufactured in considerable quantities and a view of the storeroom for the finished parts is given in Fig. 12, this room being on the ground floor. A group of racks found very convenient for crankshafts, etc., is shown in Fig. 13. Fig. 14 gives an idea of the way engines are put through in large lots.

There are numerous spur tracks about the works to facilitate the handling of incoming and outgoing freight, and one of

way of its length by fire walls, enclosing stairs and elevators; and the portion devoted to flask and pattern work has two floors, while the storage portion has four. The industrial railway runs directly into the flask shop from the foundry across an open space of about 40 feet.

FAN AND HEATER SHOP.

The building devoted to the manufacture of fans, blowers, heaters and other work of similar character is of the same length as the machine shop, *i.e.*, 500 feet. Its width is 80 feet, and its height three stories.

The lower floor is fitted up at one end

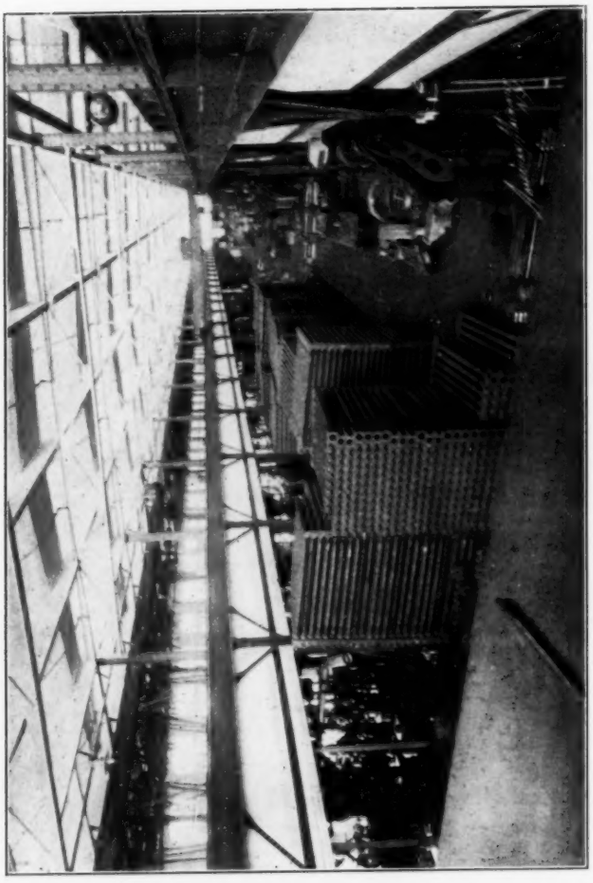


FIG. 6. INTERIOR OF MACHINE SHOP.

FIG. 8. PLANERS IN MACHINE SHOP.

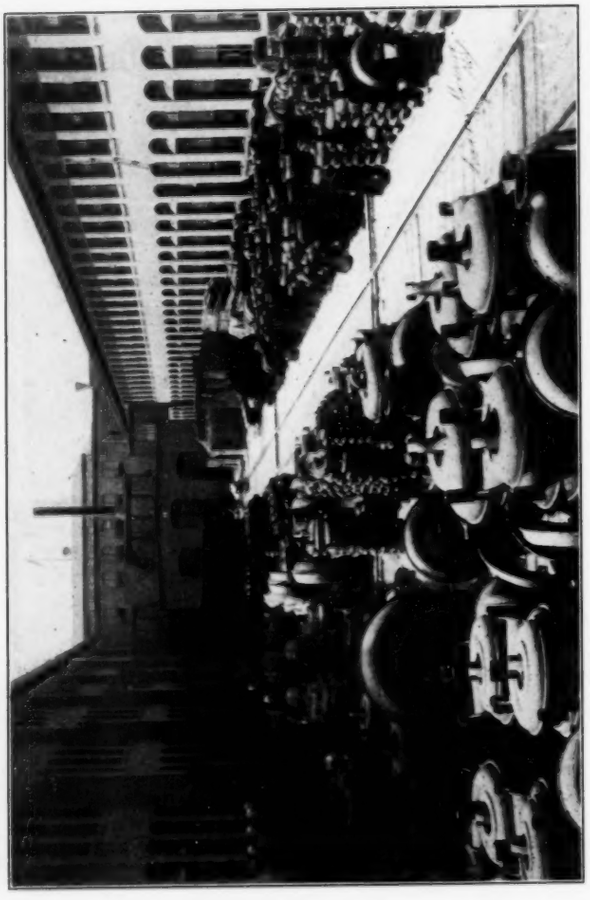


FIG. 5. CASTINGS STORAGE BETWEEN BUILDINGS.

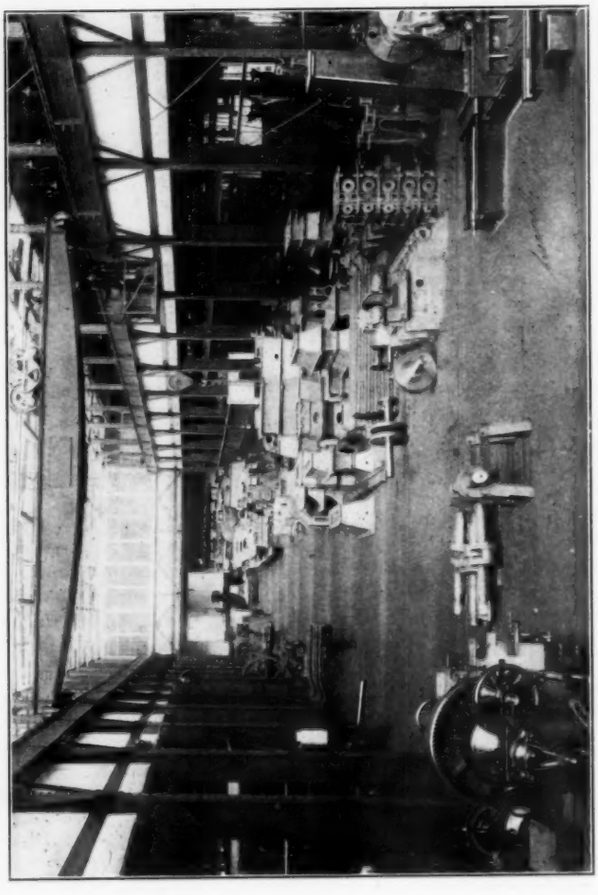


FIG. 7. INTERIOR OF MACHINE SHOP.

FIG. 9. THE TOOL ROOM.

FIG. 10. SHAPERS AND PLANERS IN THE GALLERY.

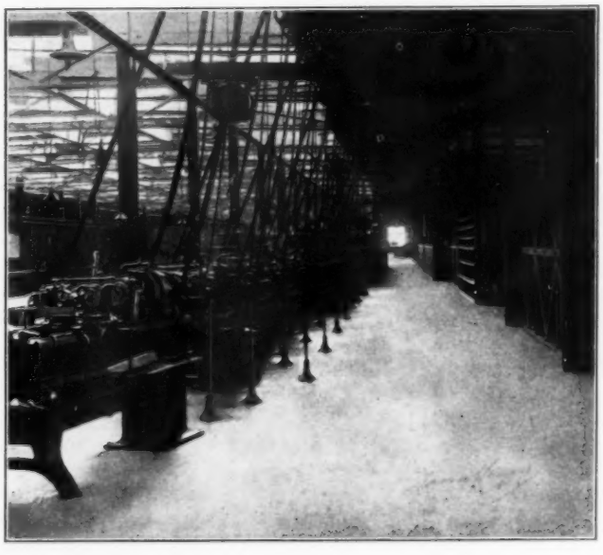


FIG. 11. TURRET LATHES IN THE GALLERY.

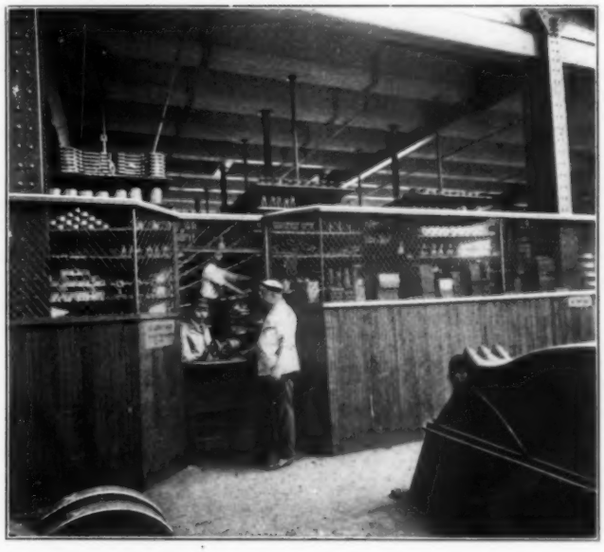


FIG. 12. STOREROOM FOR FINISHED PARTS.

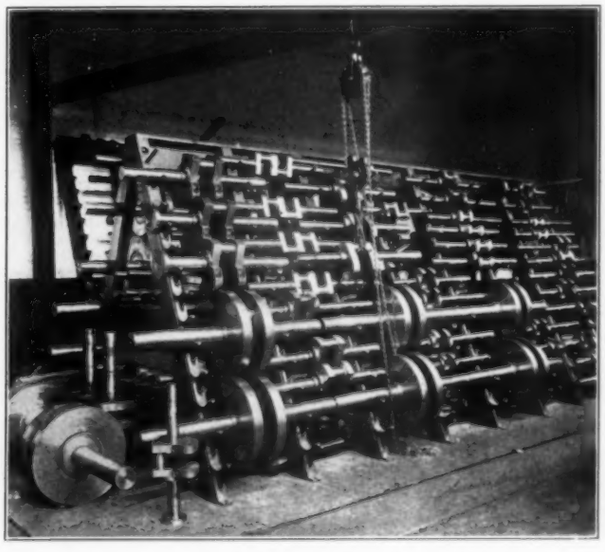


FIG. 13. A RACK FOR FINISHED CRANKSHAFTS.

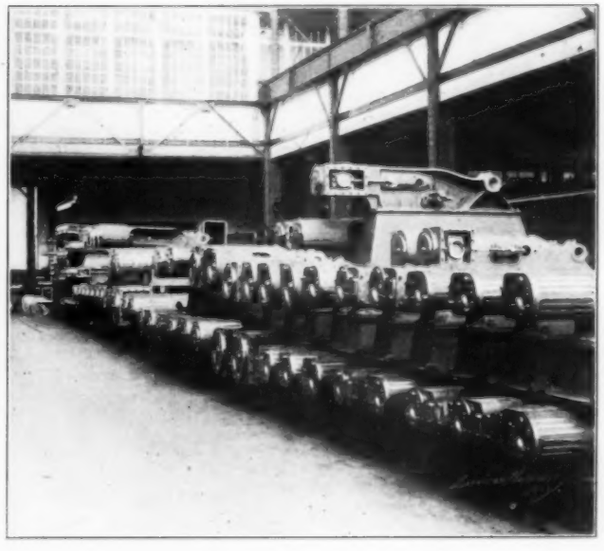


FIG. 14. COMPLETED ENGINE FRAMES.

with cutting-off and threading machines for pipe; large stock racks and general pipe-fitting apparatus. A view in this department is given in Fig. 17, showing the fitting up of heater sections. Fig. 18 is a view taken at the other end of the shop, where big fans and blowers are erected. It will be noticed that this half of the shop has for a second floor a side gallery only, thus leaving space for the operation of a 5-ton electric crane over that portion of the main floor which is used for the erection of large work.

In the space adjoining are installed large shears, bending rolls, punches, etc., for the manipulation of heavy plates; and midway of the length of the floor is the packing and shipping department near a 5-ton elevator which serves all floors. In the gallery and on the upper floor the manufacture of the various parts for fans and blowers is carried on here forges, countershafts and other material are constructed.

THE SMITH SHOP AND THE LOCKER BUILDING.

Between the fan and machine shops are located, end to end with a narrow passage between, the smith shop and the locker building, each of which is 100 feet long by 40 feet in width. The smith shop is represented in Fig. 19; a room in the locker building in Fig. 20.

The latter building is a two-story structure with lockers and wash sinks on both floors, and is used by the workmen from all departments, except those in the foundry and pattern building, which have their own wash and locker rooms. In this building there is an emergency room, where first aid to any injured workman may be rendered, the room being furnished with a cot, and various appliances likely to be of service in such cases.

ELECTRICAL AND TESTING BUILDING.

From the plan in Fig. 3 it will be seen that the electrical and testing building forms a connection between the machine and fan-and-heater shops. It is three stories high, the upper floors being occupied with armature and commutator work, with the assembling and testing of electrical apparatus, etc., and the lower floor used for erecting engines, testing direct-connected generators, and packing and shipping such machinery. A 15-ton crane serves this floor; and there is a testing plate about 30x60 feet equipped with steam and electrical connections, where engines may be run condensing or non-condensing and efficiency tests made.

Illustrations of various departments in this building are given in Figs. 21 to 24, inclusive.

There are at present about 1,300 hands employed at the plant, although it will accommodate about 2,000, and a special train runs directly into the yard to assist in the transportation of the employees to and from the works. F. A. S.

Most tool-building establishments are unusually busy, and business is increasing.

College Shop Experience—IV.

BY HARRY MARQUETTE.

One morning the "Prof" was standing in the recitation room in the shop finishing up some sketches and drawings on the blackboard which were to serve to illustrate the talk to the boys that morning, when "His Nibs" came in on his usual round of information-giving, and slid himself up on to the lecture table, where he sat with his legs dangling. After a few words of brief discussion of the weather, "His Nibs" opened another subject by stating: "I suppose you have heard that I have taken a contract for the college to light the town by electric light, and have purchased a second-hand dynamo which will be here to-day. I tell you, the college is going to have a cinch on this proposition. I will make money enough off this contract to pay all of our own lighting expense; and as for the outlay, that is entirely negligible."

When noon came, the "Prof" on his way back from dinner dropped around to the railroad station, where he found on a flat car an antiquated, belt-driven dynamo, of the style of the old days when long-field cores were in vogue. The driving pulley was only 10 inches in diameter, and there was a tag fastened to it saying that it should make 1,800 turns per minute.

While observing the old relic "His Nibs" came riding up on his buckskin pony. By this time he had become sufficiently Westernized to assume a broad-brimmed hat and a *very* "well-gentled" pony. The first remark from the rider was, "Isn't she a beauty?" The "Prof" then remarked, "It is evidently quite a machine and seems to be in good repair." This was all he had a chance to say, on account of the large amount of information which was imparted to him, some of which was as follows: "I tell you, no one but a fool would design a machine with such a small pulley as that; I am going to take that off and put on a 14-inch pulley; then just look at it, it is an iron pulley and is worn bright as a mirror by belt slippage. I am going to put on a 14-inch wooden pulley, and you will be surprised at the good results it will give."

During this time the "Prof" had been jiggling his slide rule and had discovered that the circumference of a 10-inch pulley travelling at 1,800 revolutions per minute would represent a speed of between 4,700 and 4,800 feet per minute, which is pretty close to the limit for any kind of flat belting, and that a 14-inch pulley to make 1,800 revolutions per minute would necessitate a belt travel of nearly 7,000 feet per minute if the belt thickness were added to the diameter of the pulley. These slide-rule calculations made him believe that he would undoubtedly be surprised at the manner in which the machine behaved with a larger pulley.

The next few days were exceedingly busy ones for the power-house boys, but they succeeded in getting "Old Antediluvian," as they had promptly nicknamed the machine, into place. These boys might be lacking in college education, but the mines at which they had worked were equipped with the latest and best of electrical machinery, and they were not slow in placing the little machine in its proper epoch.

When it came to making the change in the pulley there was loud and pronounced remonstrance on the part of the boys at the plant. "Red Frank," the former hoisting engineer, had a wholesome dread of belts running at abnormal speeds, and it is needless to say that "Farmer Bill" had had some experience with belts in connection with his threshing machine; but all protests were useless. The proper sized pulley was arranged on the jack-shaft, a wooden pulley installed on the dynamo, and so sure was "His Nibs" of the success of his new plaything that he invited all the professors down to the plant to see the machine start. The engineers had both flatly refused to start up the machinery, but "His Nibs," who had the courage of his convictions, opened the throttle and let her go. As a temporary job they had taken a rubber belt which they had on hand and simply laced it.

By the time the machinery was up to speed one would think, by the din, that in place of being in an electric-light station he might be attending a Chinese New Year's celebration. This racket was caused by the air pocketing under the face of the belt on the pulley and escaping from the edges with a series of sharp pops or explosions.

When the machinery came up to speed the lights became bright and remained so for a few moments, when there was a frightful shriek as the belt slipped on the driving pulley, the lights went out, and so did the faculty, at least all who had succeeded in holding their nerves steady enough to remain up to that time. All the efforts made that night only resulted in the repetition of the celebration with a grand final screech from the belt as it slipped off the driving pulley and a lightning jump of "Red Frank" for the throttle every time the shriek let go. The belt lacing gave out, likewise the patience of everyone except "His Nibs."

As already stated, the "Prof's" slide-rule calculations had prepared him to expect almost anything from "Old Antediluvian," on account of its abnormal mountings, but he was not the only one who recognized the fact that there was trouble in sight.

Next day, when he was working in the little cubby-hole which he called his office, a young man with a comprehensive eye strolled in and presented a card showing that he was the Rocky Mountain representative for the electrical company that

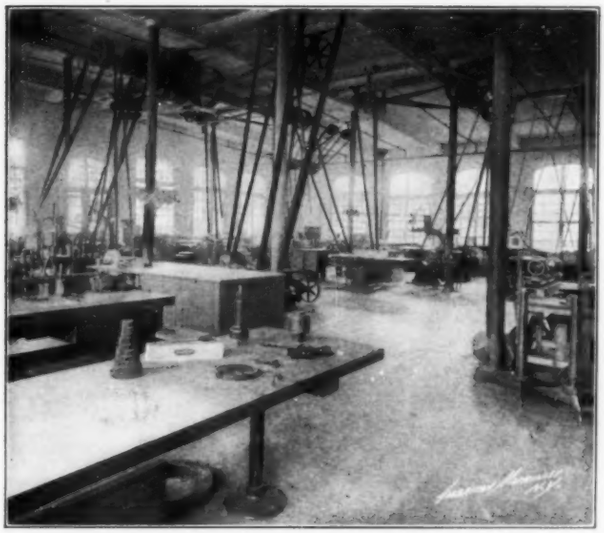


FIG. 15. THE PATTERN SHOP.

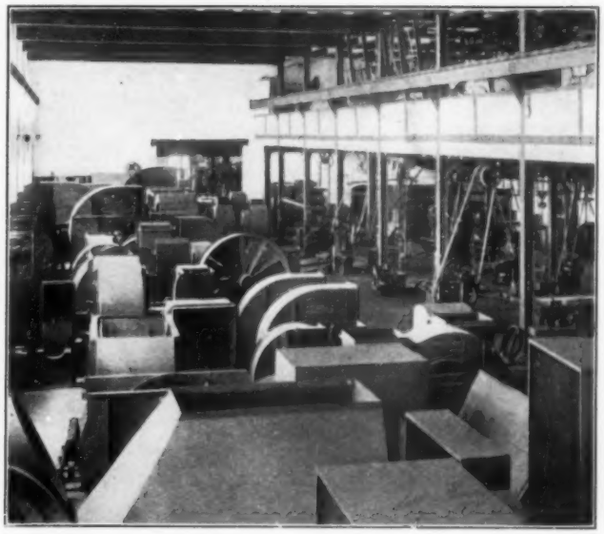


FIG. 18. ERECTING FLOOR FOR FANS AND HEATER JACKETS.

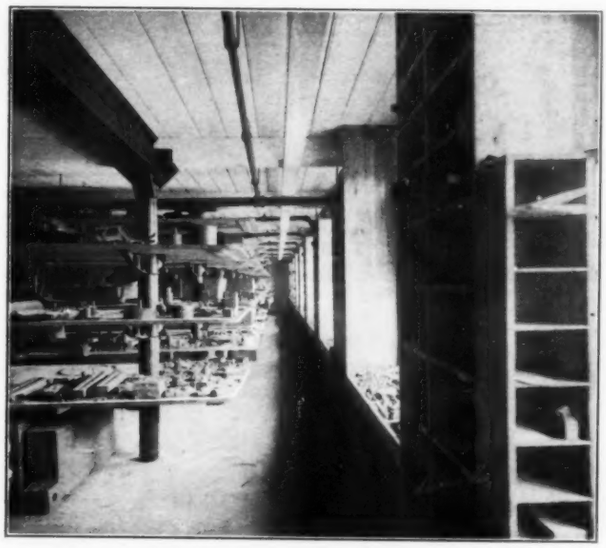


FIG. 16. THE PATTERN STORAGE.

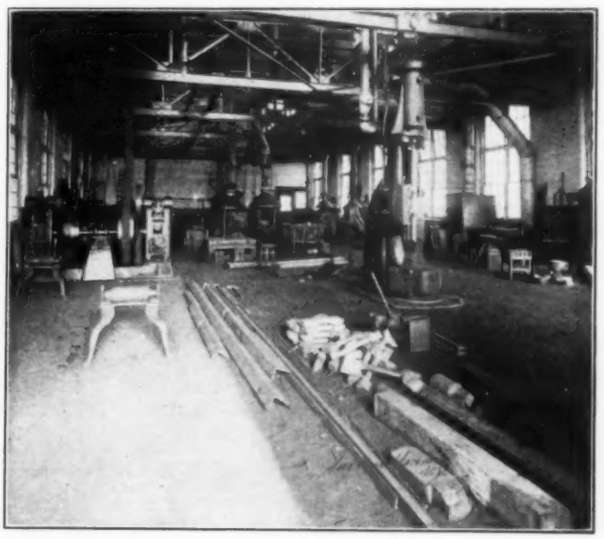


FIG. 19. THE SMITH SHOP.

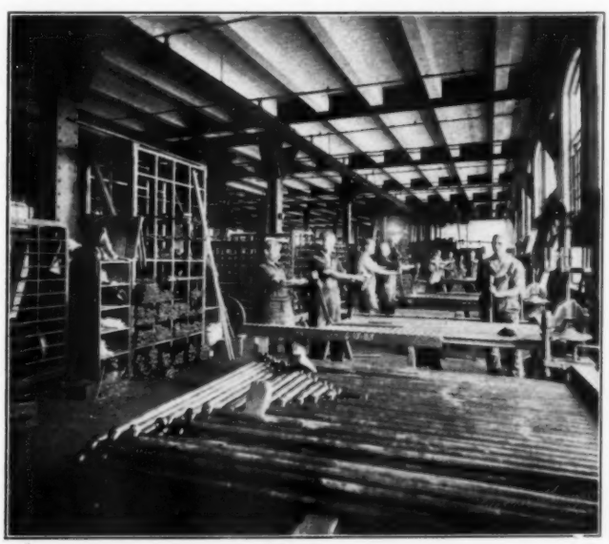


FIG. 17. HEATER DEPARTMENT IN FAN BUILDING.

FIG. 20. VIEW IN LOCKER BUILDING.

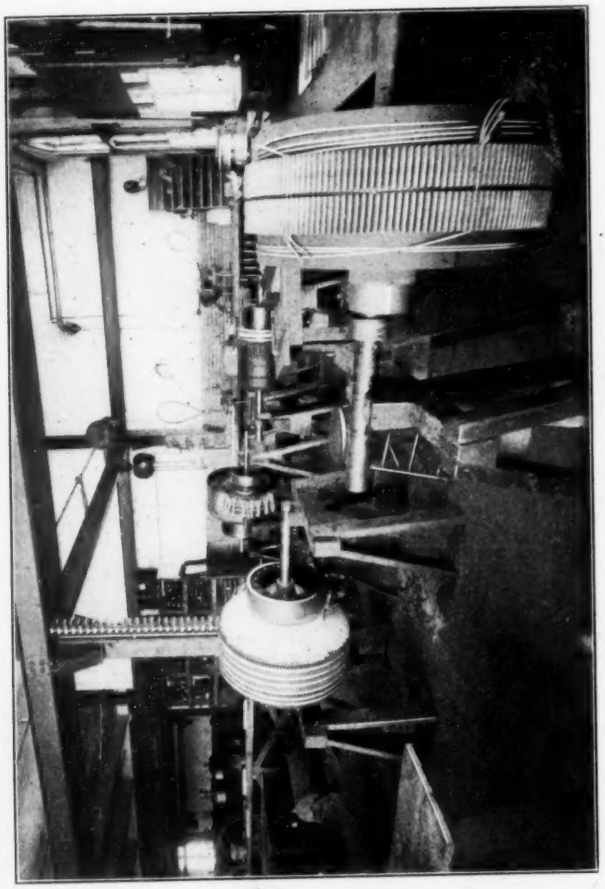


FIG. 22. WINDING ROOM IN ELECTRICAL DEPARTMENT.

FIG. 24. THE TESTING SWITCHBOARD IN ELECTRICAL DEPARTMENT.

FIG. 21. WINDING ROOM IN ELECTRICAL DEPARTMENT.

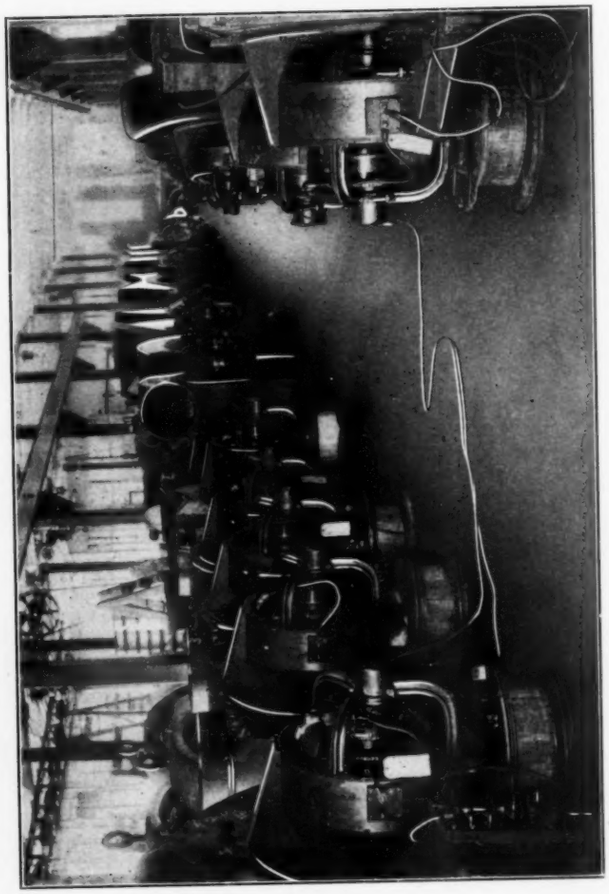


FIG. 23. TESTING FANS IN ELECTRICAL DEPARTMENT.

had made the dynamo in question. After a conversation touching pretty much everything, from the glorious climate to the mineral resources of the region, the salesman gently approached what he evidently feared might be a sore point, by stating, "I see you have one of our old-style machines installed in your plant; that is a type that we used to be very proud of, and with careful handling it is still capable of doing very good work." The cautious way in which he made these remarks, and the sly smile playing around the corners of his mouth, showed that he evidently feared that he might be on dangerous ground. The "Prof" immediately set him at rest on this subject by saying, "Oh, it isn't any of my babies; go ahead and express your mind freely; my jurisdiction ends at the back door of the shop, and I can appreciate some of the fun that is going on down under the cliff." The salesman dropped his reserve, relieved his feelings with a good langh, and then said, "I am glad to find that I can speak freely on the subject, for we never like to have our machines put in a bad light, and there is sure to be plenty doing if that big wooden pulley is left on the machine. The pulley which we supplied with that machine is as large as it can be made without exceeding safe belt speeds." The two men then compared notes and the "Prof" told his visitor of the antics which had taken place to date.

By the next night a cemented joint had been made in the rubber belt, and things actually ran for about three hours, which was as long as the lights were required. In the meantime a belting agent had been summoned up from a nearby supply town, and had taken an order for a double rawhide belt, warranted to stand the conditions.

Three days, or rather, three nights, was the life of that rubber belt, though under proper conditions it should have done duty for a year. As the rawhide belt would not be there for a week, a double oak-tanned leather belt, with a carefully made, glued joint, having a lap of about 4 feet, was installed. This was so stiff at first that it did not work well about the smaller pulley, and with the shrieking, slipping and squealing, to vary the monotony for the engineers, accompanied with marked fluctuations in the lights, the show went on.

By the fifth night, however, the leather belt had had such punishment that it was limp as a rag, and the dynamo had been drawn back to the extremity of its belt-tightening screw.

About 9 o'clock of this night the 14-inch pulley came into action. No one had realized that it was loaded, but all the same it went off, one piece leaving its mark in the roof, another piece striking one of the side walls, and smaller splinters flying all over the room. As for the leather belt, it got tangled up around the other dynamo, and then wrecked the 42-inch pulley on the jack-shaft. This all occurred before either engineer could get to the throttle. As a consequence, nobody at the college had lights for two days, and "Old Antediluvian" had a rest of three days while waiting for its new rawhide ribbon and a new pulley.

These antics of "Old Antediluvian" were rather more far-reaching in their effects than would at first appear, for every time the old fossil went on a tear it would succeed in shutting down the entire plant for a greater or less period. This stopped the two modern generators which were used for lighting the college buildings and faculty houses, and also for furnishing power for the shops.

When that new rawhide belt came it was a beauty; it was a double belt, the parts of which were warranted to be cemented with waterproof elastic cement. It had been made for the place where it was to go, and was endless, the splice having been put in very carefully by the parties who furnished it. In order to get it into place it was necessary to take the belts off from both the other dynamos, which stood at the end of the building. It was also necessary to raise the jack-shaft out of its bearings so as to enable the belt to pass over the various pulleys, but when it was finally in place it was found to be exactly the proper thing when the take-up screw was extended as far as possible.

Needless to say the citizens of the thriving little mountain town, who had never known the luxury of electrically lighted streets before, were all taking a lively interest in the progress of events at the lighting plant, and the two local weekly papers, *The Golden Eagle* and *The Squaw Gulch Miner*, were devoting a half-page or so in each issue to the progress of events at the plant; practically all of which the citizens had heard by word of mouth before the papers came from the old hand-presses. In fact, many of the readers had visited the plant after each act in the comedy.

The behavior of the rawhide belt was to furnish the last crowning act in the play. In the first place, though the ribbon belt had been guaranteed not to stretch excessively, it was certainly too much to expect miracles of common prosaic rawhide, and to the strenuous tune of about seven thousand feet a minute it was stretching so rapidly that in four days the fifteen inches of take-up afforded by the screw had all been used. The inventive genius of "His Nibs" was not to be balked, but shone forth at this point once more. The belt slipped so excessively even under the new conditions that the lights were unsteady, and as a consequence he ordered the driving pulley on the jack-shaft to be lagged up one inch and covered with a piece of leather belt to increase the friction.

The new rawhide belt was perforated and hence did not give any pneumatic fire-cracker celebrations, as the air had free access through the belt, and this lack of noise had lulled even the suspicious engineers into a sense of security. The lagging of the large pulley of course permitted the take-up screw to get a new hold, but its new lease of life was exhausted in two days. After that the belt was allowed to stretch for another two days, when it began to whip dangerously close to the floor. One night "Black Mac" had just made his round to feel the bearings of the different machines, and on his way back to his post near the engine had just passed the wooden pulley on "Old Ante" when he suddenly became aware that something was doing. Some kind of a big black snake was whirling around behind him, a chair which chanced to be standing against the wall in line with the belt was reduced to kindling wood, and then suddenly the disturbance started on the opposite side of the room near the jack-shaft. By this time the nervy engineer had his engine shut off, which of course left him in darkness on account of the stopping of the dynamos.

Seeing that the lights had gone out, and wondering what next, the boys from the boiler-room came tramping up with a couple of lanterns and an investigation showed that while that cement in the rawhide might be elastic under ordinary circumstances, it was nevertheless unable to withstand the gait at which it had been going, and hence the outer layer had parted company with the inside, its splice had broken, one end of the belt had slapped out against the wall and smashed the chair, and then it had jumped over behind the jack-shaft where it became entangled with the set-screw on the collar near one of the bearings, and the two ends went flopping around beating the floor.

The strange thing about the whole performance is that the inner layer of the belt had remained on the pulleys, and that when "His Nibs" warned by the lack of light in his house, came running down into the plant and ordered them to start up again, that inside layer proved sufficient to drive "Old Antediluvian" the balance of the evening. Needless to say, after that no one of the engineers would pass that belt while it was running; but they made arrangements so that one of them stayed on one side to keep track of the dynamo bearings, and the other remained on the other side to look after the engine. When morning came a daylight inspection showed even to "His Nibs" that it was folly to pursue that tack any longer, and as a consequence he said to "Red Frank," "I know I was right on the size of that pulley, but since that belt has played out I think maybe you had better put the 10-inch pulley on to the generator and a smaller one on the shaft, and we'll try it that way for a few days." The trial, however, lasted for over a year, or until a fire put "Old Antediluvian" out of business for good.

The Use of Fuel Oil on the Pacific Coast—II.

EDITORIAL CORRESPONDENCE.

OIL FUEL IN THE BLACKSMITH SHOP.

In no place does oil fuel show to better advantage than in the blacksmith shop, where the absence of smoke, ashes and general litter, with constant readiness for work, must be seen to be appreciated. Fig. 9 shows a good-sized oil-fired forge fire at the Llewellen Iron Works at Los Angeles, and Fig. 10 shows a larger heating furnace supplying a steam hammer at the Southern Pacific shops, Los Angeles, and arranged for utilizing the waste heat in steam-making for the same hammer. This combination is very common; in fact, nearly universal. Another case of it is shown in Fig 11, which is from the Sacramento shops of the Southern Pacific road, the glowing axle under the steam hammer showing the size of the work here done. The camera, unfortunately, was here so located as to take in but part of the furnace, which has in reality two doors.

DESIGN OF OIL-BURNING FURNACE.

The furnaces used at these shops, of which there are many, are of the design of Mr. S. Uren, master blacksmith of the shop. It is shown in three sections in Fig. 12. The peculiarity of the furnace lies in the burner and flue to the boiler being located at the same end, the burner being at the top at *a* and the flue at the bottom at *b*. The heat shows no tendency to take a short cut to the flue, but fills the furnace with a uniform glow that is the perfection of conditions. The rolling-mill furnaces of these shops, in which scrap iron is worked up into new forms, are of this construction and are, perhaps, the only rolling-mill furnaces in the world to be fired with oil. An essential condition of these furnaces is the parallelism of the center line of the burner with the roof of the furnace. Should the burner incline upward, the result is a deposit of carbon on the roof of the furnace, accompanied by unsatisfactory working.

A LOW-PRESSURE BURNER.

Fig. 13 shows the burner used in these furnaces. It is the design of J. G. Camp, and is patented. It is of the low-pressure type, using air at about 8 ounces pressure only from a fan. The air supply will be seen to be divided, a portion of it meeting the oil at *a* and the larger portion going by the pipe *b* to the outer nozzle pipe *c*.

The action of these furnaces and burners is perfection itself—silent and as free from smoke at the top of the stack as the chimney of a Welsbach burner. While difficult to explain, it is the universal testimony of those using these furnaces that the oil seems to give a more mellow and penetrating heat than coal.

Of course the economy of labor in handling the fuel is an important item with oil fuel. When coal was used at these shops six men were required to handle it, while a horse and cart were constantly engaged in hauling ashes. Now one man handles the oil, and, of course, there are no ashes. The saving of time in cleaning fires and disposing of ashes leads to an increased output of about 20 per cent.

SMALL OIL-BURNING FURNACES.

Fig. 14 shows some smaller furnaces, most of which serve bolt headers. Their arrangement is essentially the same as that of Fig. 12 to a reduced scale, except that the discharge, being from the top and without a stack, the burner is placed at the bottom. Some of these furnaces have openings for work on both sides and others on one side only. Fig. 15 shows the burner used with these furnaces, which also uses air at low pressure from a fan.

Many furnaces of sizes intermediate to those shown are in use about the Sacramento shops. The Ajax forging machines, of which Mr. S. T. Uren has shown the dies at page 213, are all served by oil furnaces.

SPECIAL OIL-BURNING APPLIANCES.

Fig. 16 shows a set of special burners used for heating driving-wheel tires for shrinking on, with which there is a good deal of smoke, as is obvious, but being out of doors this does not matter. The set comprises four burners, two of which are concealed by the smoke.

Fig. 17 shows another special rig for heating tires in order to remove them. The rig is portable, as is obvious, and with it tires may be removed without taking the wheels from the engine. The outfit shown in Fig. 16 burns crude oil, but that shown in Fig. 17 burns gasolene. Figs. 18 and 19 show two additional special portable devices from the Union Iron Works, of San Francisco, both of which burn crude oil. Fig. 18 shows a riveting forge, and Fig. 19 a portable heater, of which a leading use is in the removal of propeller wheels from their shafts after use.

GAS-FIRED FORGES.

One of the most interesting uses of oil on the entire coast is in the blacksmith shop of the Union Iron Works, though it may savor slightly of a Hibernianism to call it a use of oil, since the fuel, as burned, is gas. The plant is very similar in principle to the small plants for lighting isolated dwellings which have found considerable use, except, of course, that this one is much more highly organized. The gas-making plant is so located as to make it impossible to get a satisfactory photograph of it, and Fig. 20 from another similar plant by the same makers—the Acme Gas Company, of Chicago—is therefore used. A blowing engine, not shown, compresses air to about 8 pounds pressure, and a portion of this air goes

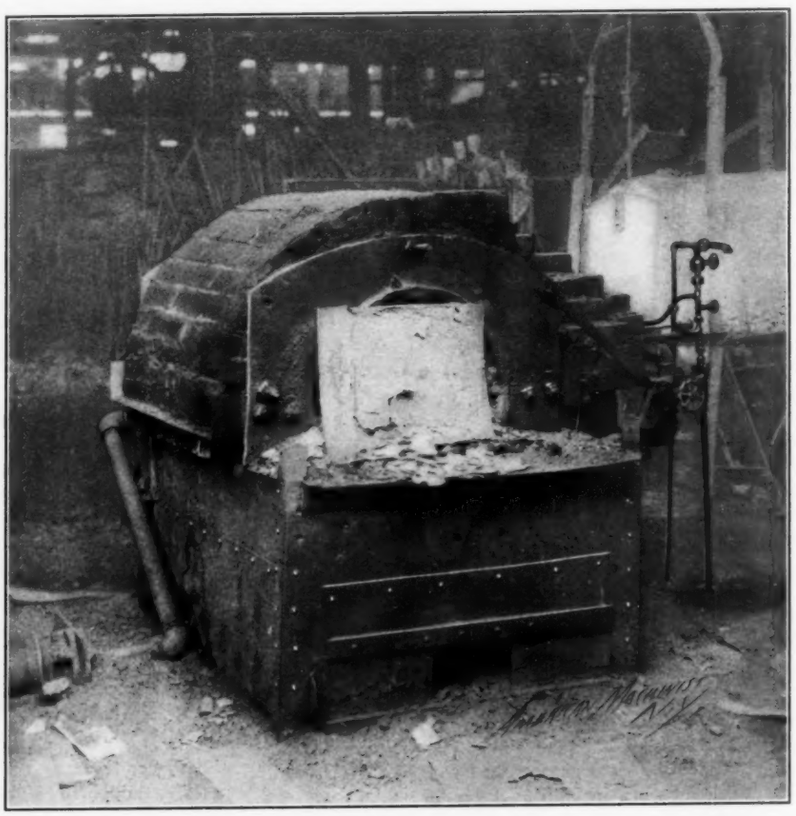


FIG. 1. AN ORDINARY OIL-FIRED FORGE.

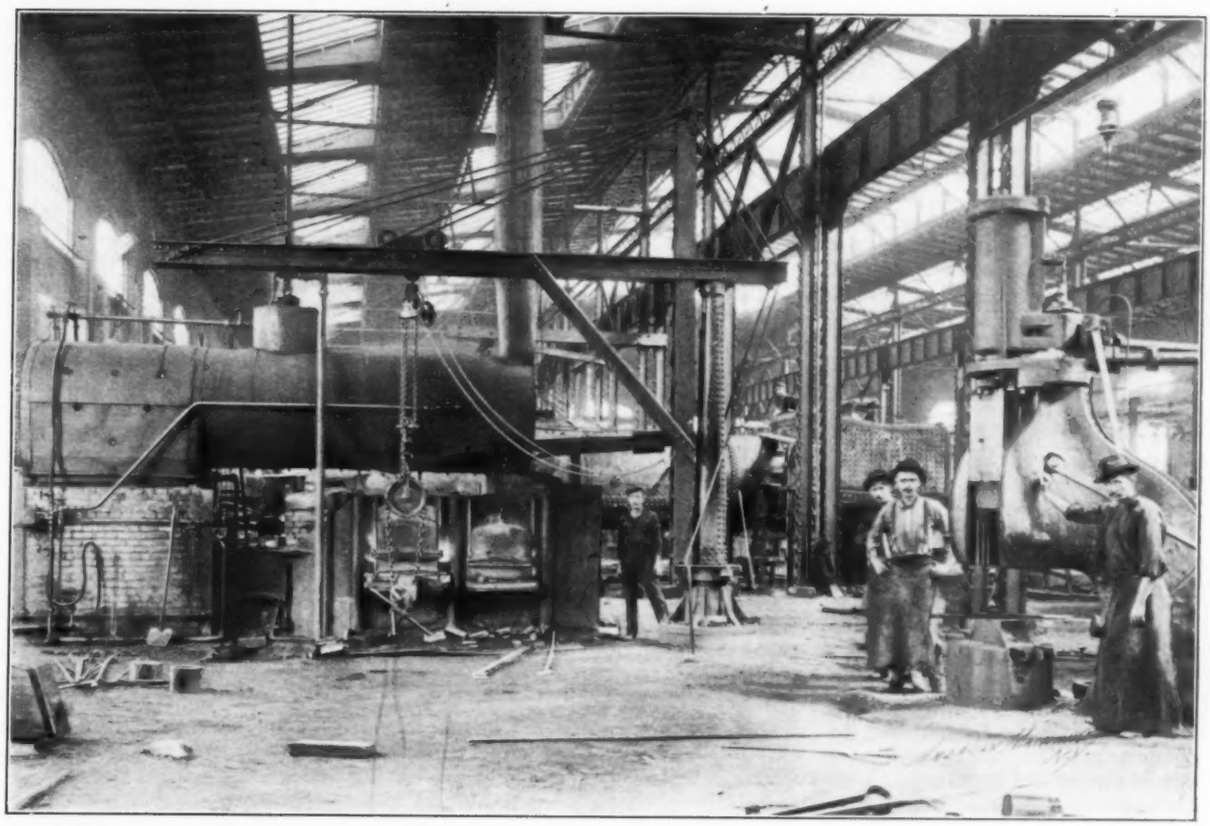


FIG. 10. MAKING STEAM WITH WASTE HEAT FROM AN OIL-FIRED HEATING FURNACE.

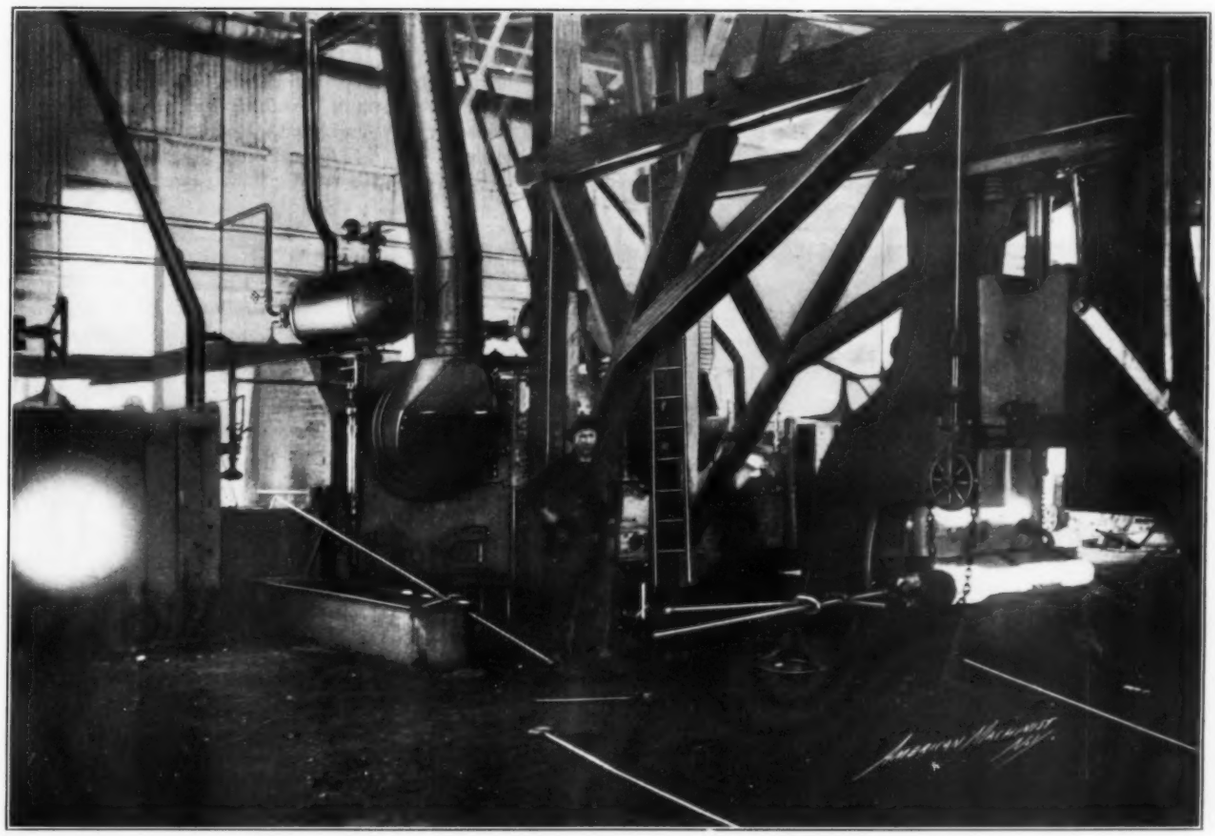


FIG. 11. ANOTHER COMBINATION OF HEATING FURNACE AND STEAM BOILER.

through the series of upright tanks in succession, while the remainder goes to the shop in a special air-pipe line. The tanks are partly filled with gasolene of varying gravity, the heaviest at the beginning and the lighest at the end of the series. The air pipe is carried down into the gasolene and, rising from it, carries the vapor with it, the vapor growing richer and richer as the air passes through the tanks. Each tank has a gage glass of such large size as to contain a hydrometer, so that the gravity as well as depth

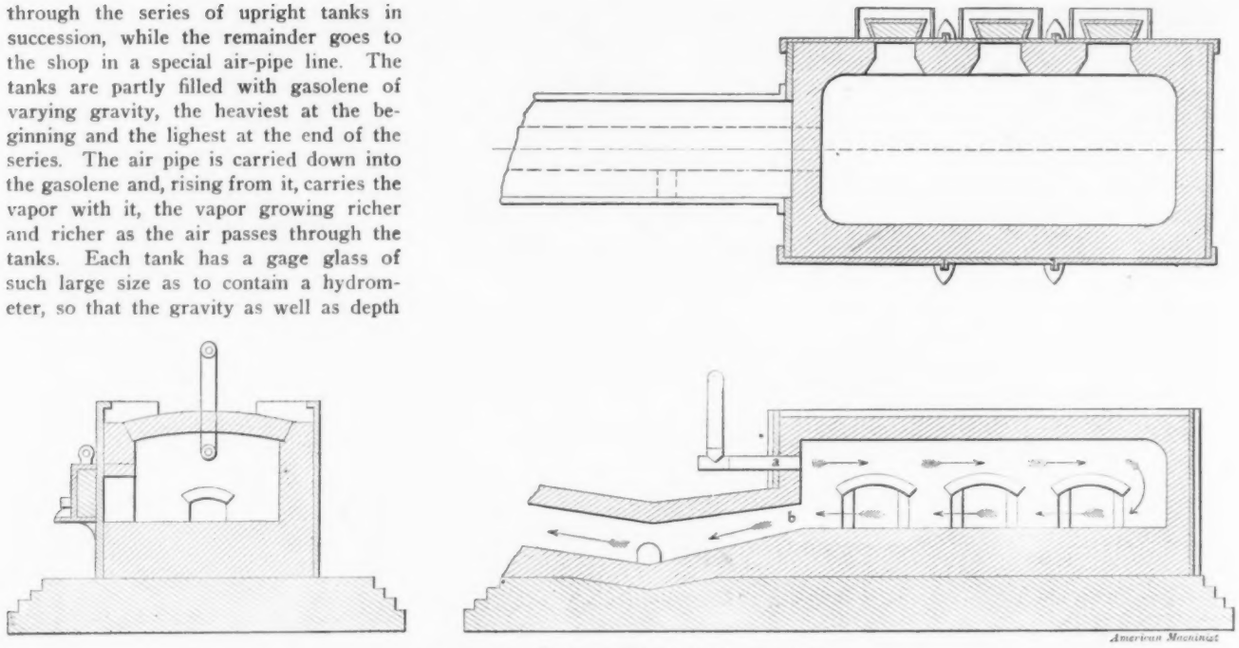


FIG. 12. UREN'S OIL-FIRED HEATING FURNACE.

of the gasolene may be read. As the evaporation goes on, the gasolene decreases in amount and increases in density and from time to time is transferred from tank to tank by a system of pipes and a pump, the level and density of the contents of each tank being thus kept substantially constant and the quality of the gas uniform. Keeping the different densities of gasolene in separate tanks is found to result in consuming practically all of the gasolene. When run at its normal capacity there is, in fact, no waste. When forced beyond its proper capacity there is a waste of two or three per cent.

Fig. 21 shows two of the smaller forges using this gas. The air and gas pipes will be seen hung from the wall, the upper one being the air pipe. Of course the passage of the air through the gasolene tanks absorbs part of the pressure, the result being that air which enters the first tank at 8 pounds pressure leaves the last one with but 4 pounds, and these pressures are carried to the forges. The forges and burners are of the simplest possible construction, the former being but a cavity in a mass of fire-brick with loose bricks on top to retain the heat. The burner for such a forge as the one shown in Fig. 21 consists of a piece of ¾-inch piece arranged within a piece of 2-inch pipe—the smaller carrying the gas and the larger one the air, the connections being as shown in Fig. 21. The short pipe ends about 4 inches within the large one. The S-shaped affair in the gas pipe of Fig. 21 contains a device to prevent possibility of back-firing. Fig. 22 shows a much larger forge in the act of heating a 6x10-inch bloom. With this two burners are used.

If oil fuel in a blacksmith shop represents comfort, gas fuel represents positive luxury. Nothing finer than this shop can be imagined. It contains twenty-two gas-fired forges, and no coal has been used within it for four years. F. A. H.

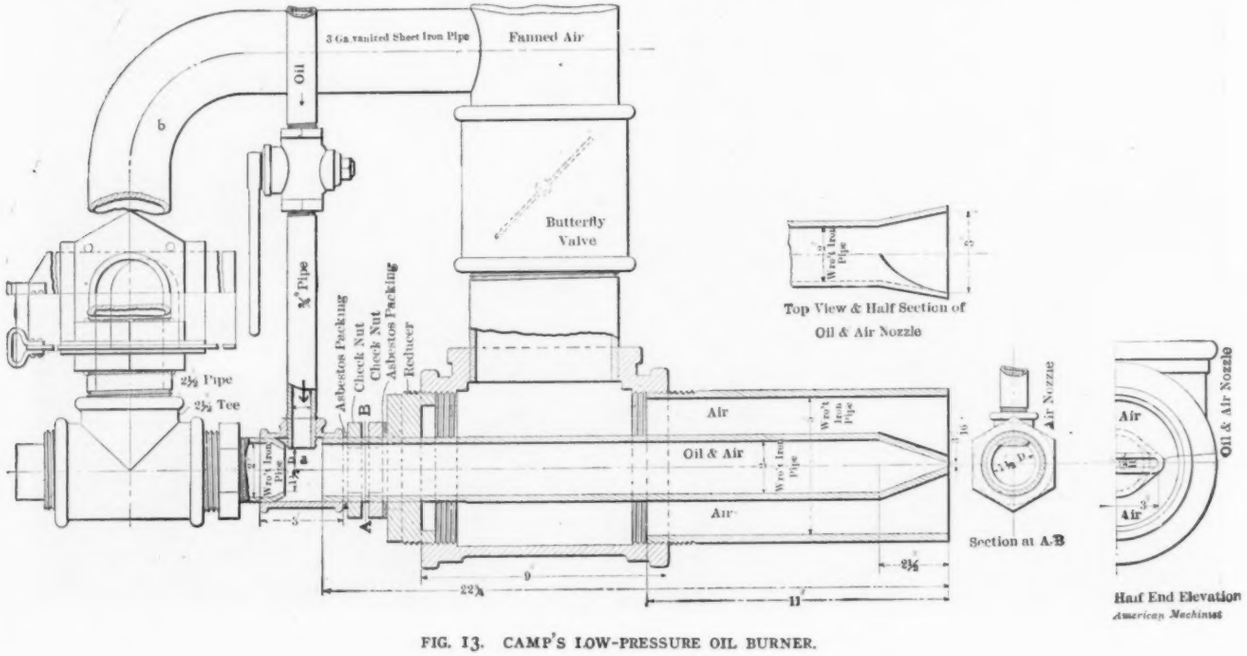


FIG. 13. CAMP'S LOW-PRESSURE OIL BURNER.

Letters to the Editor.

Dimensions on Drawings.

At page 224 Mr. Falardeau has something to say on the subject of dimensioning drawings that seems to call for another word, for while he does not make direct reference to my article at page 835, Vol. 28, Part 1, he seems to have read it. As "the shoe fits" without pinching, however, I will put it on. He seems to dislike to have the patternmaker and draftsman consult over a drawing, his ground being that the patternmaker will lose more time running around after the draftsman than the draftsman saved by leaving off his dimensions. To this I take two exceptions. First, that this is not at all a question of the time saved or used by either draftsman or patternmaker, but of the time saved in the machine shop by having a clear drawing unhampered by dimensions for which the machinist has no use. Drafting and patternmaking have to be done but once, machine work we usually expect to have done many times over. His remedy for a complicated drawing is to add another complication; for, as another of your correspodnents has shown, these circular dots are easily to be confused with other accidental marks. The other exception which I wish to take is that the draftsman ought to be in persistent communication with all departments that have to use his drawings till they have proved correct or have been corrected.

I don't like to see a patternmaker running to the drafting room, but I do think that any draftsman ought to have the freedom of the shop and that he should follow up his work close enough so that no one would have to run after him. He is liable to find out a whole lot of things. In fact, I think that the most trouble with draftsmen usually is that they are so cooped up and kept away from the men who use their drawings that they come to consider themselves little tin gods, especially set aside to dictate their pleasures to others. If they should break into the foundry once in a while, it wouldn't hurt them. I know that in many shops the draftsmen are held pretty close to their boards, but I believe it to be a costly practice. Thinking is not readily done by rule, and upon a draftsman's thinking powers the fate of many a manufactory has stood. I knew of a draftsman once who used, when he struck a particularly knotty point, to disappear, perhaps for a few hours, perhaps days, but when he came back he had it worked out. This was back in the times when employers were acquainted with their help and they paid him not for his time, but for his work.

Then, again, Mr. Falardeau objects to having a patternmaker scale drawings. If a draftsman is as careful as he ought to be, he will have no objection to anyone laying a rule on the original of his drawings. If he changes a dimension without changing the drawing, he surely ought to indicate it. Generally speaking, of the patternmakers and draftsmen I have met, the patternmakers were the most competent to measure. As for such extreme scales as he suggests, just see what an eighth of an inch to the foot means. Suppose we have a sheet of paper on which we can only make a drawing 20 inches long without crowding. At ⅛ inch per foot this will represent an object 160 feet long. This is not patternmaking; it may be shipbuilding or railroading. The times when a patternmaker has a drawing to

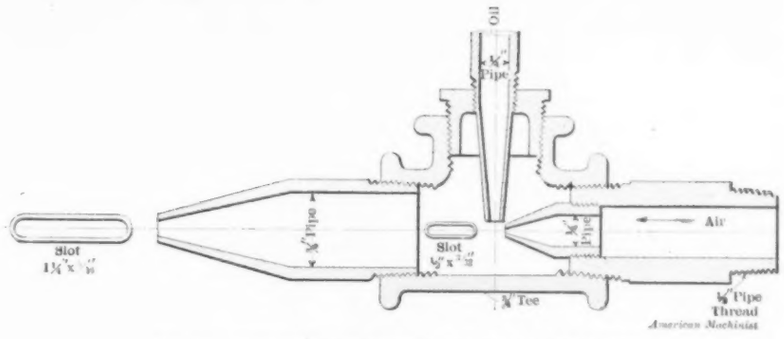


FIG. 15. LOW-PRESSURE BURNER FOR SMALL FURNACES.

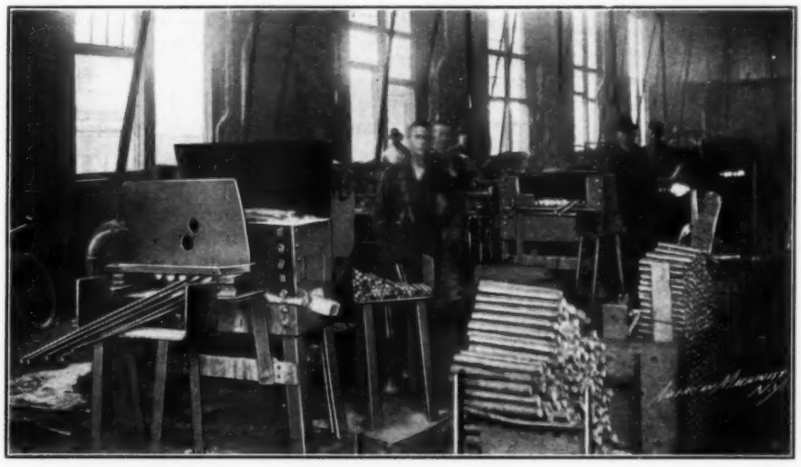


FIG. 14. BOLT-HEADER FURNACES.

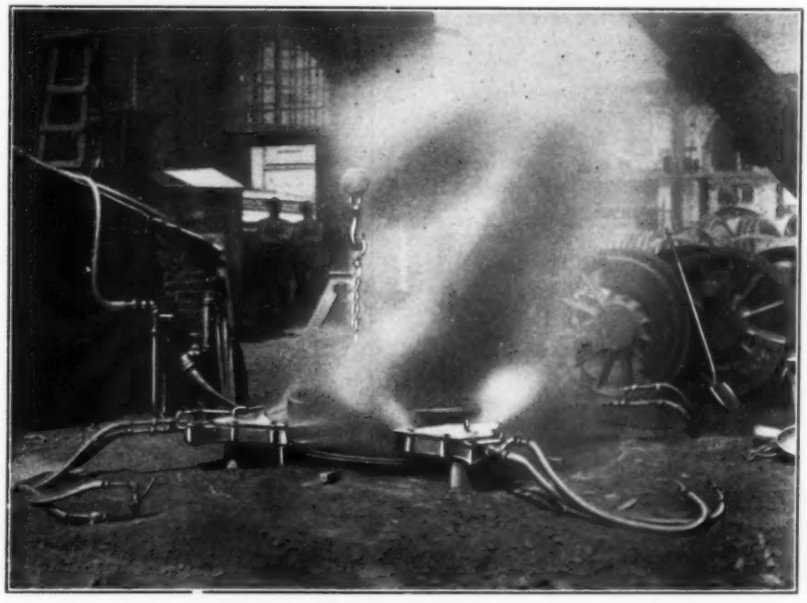


FIG. 16. HEATING DRIVING-WHEEL TIRES.

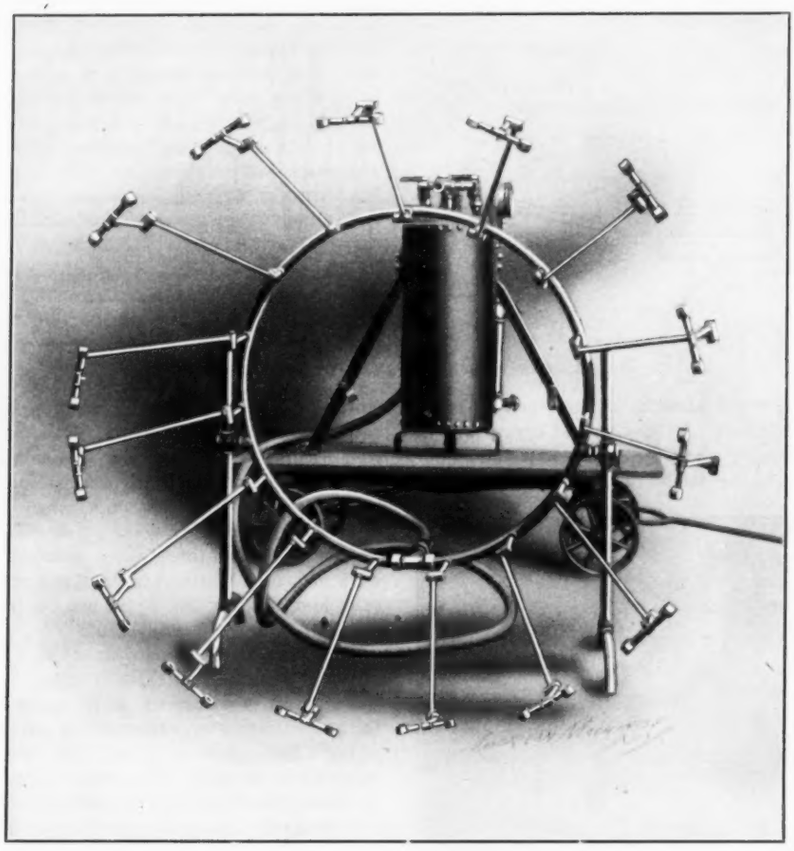


FIG. 17. HEATER FOR REMOVING DRIVING-WHEEL TIRES.

work from on which the scale is finer than ⅛ size (1½ inches per foot) are so few that they may be called the exception that proves the rule. On such a scale it is easy to do work that can be scaled easily and with sufficient accuracy everywhere except in the places which I originally excepted, namely, where pieces come actually together, where finish is to be allowed and where small clearances must be provided for.

The proof of the pudding is in the eating, however, and the fact that I have used my method over ten years with good results is to me a good argument. This very summer I have had a chance to compare my method and the use of assembly drawings in the shop, which I advocate, with the use of fully dimensioned details. We took the job of building a machine from a full set of detail drawings. The drawings were guaranteed to be reliable and they were, as far as they went, but they couldn't talk, and we could get no assembly drawings. It was worse than a Chinese puzzle to fit all these parts together. Of course we tried to match them up in our minds before we made the parts, but as there were some thousands of parts we didn't fully succeed. We had a row of holes with center distances carefully marked and which we laid out with a magnifying glass and which proved to be only to let the wind whistle through and we had other holes which we thought were to bolt the machine to the floor, but which it proved had to match up with some more holes in something else, and so it was all around.

Without the assembly drawings or the designer close at hand we are apt to be in just this predicament. If assembly drawings are made, it is much easier to put on the essential dimensions and go ahead and build the first machine, and then after the machine is just right, get out jigs and detail drawings. It is less of a puzzle to pick details out of a general drawing than it is to discover how a crazy patchwork quilt goes together with only the separate pieces to work from.

ENTROPY.

"Reducing the Thickness of Long Keys."

I notice at page 291 the method of machining cold-drawn key-steel by "Texas."

Our plan is to first heat the pieces to a dull-red, not enough to raise a scale. This will remove the rolling strains, and the stock will not spring much in machining.

P. W. POST.

Some Questions in Connection With Tool Design.

Relative to the article of A. B. C. on tool design, at page 289, I agree with him on all his suggestions, with the exception of the one referring to the Woodruff key, which he thinks is all right in its place, but not on the spindles of a lathe which carry the change gears.

A fixed key or feather, of course, has the advantage of fitting endwise; but a Woodruff key, when properly fitted (which is an easy matter) is in no danger of falling out, even with very rough usage. When building the lathe, after the Wood-

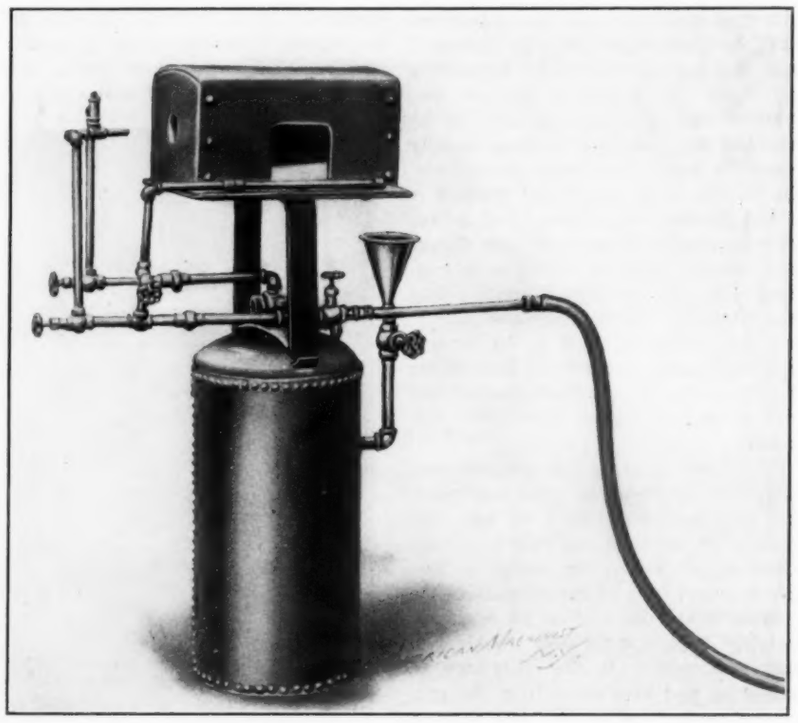


FIG. 18. OIL-FIRED RIVET FURNACE.

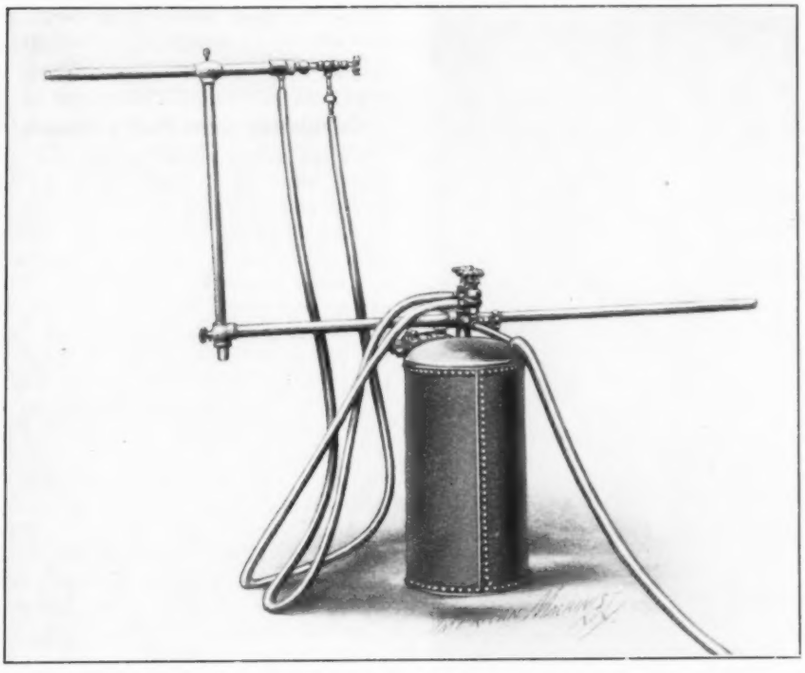


FIG. 19. OIL-FIRED PORTABLE HEATER FOR REMOVING PROPELLER WHEELS, ETC.

ruff key is pressed into the shaft, it would be a convenience to the operator if the key were turned or faced ⅛ inch shorter than the thickness of the hub on the change gear, with the same object in view as suggested by A. B. C.

A serious defect in lathe design of a well-known manufacturer is the distance from the bolster on the tool-post to the center of the lathe. A 16-inch lathe of this make has a tool-post which will carry tools ⅝x1⅜ inches. The distance to the center equals only 15-16 inch. The bolster and washer are made so thin that this defect cannot be corrected by reducing their thickness. G. HUBER.

Reading the Advertisements.

To say the article at page 126, Part II, on "Reading the Advertisements," interested me, would hardly be emphatic enough, as I have discovered by experience that anything with W. Osborne's name appended thereto is well worth the time to read, his "Echoes from the Oil Country" being full of interesting items and ideas, showing he is one of those very capable and practical men who help to keep up the high standard of reading matter obtained by the AMERICAN MACHINIST. As your readers are acquainted with what a practical man thinks of advertisements, I think it might interest a few to know how advertisements can help a draftsman in his work.

First of all, however, I would like to say that I think the AMERICAN MACHINIST is an ideal paper for draftsmen. It embodies the one thing lacking in a draftsman's work: that thing which enables

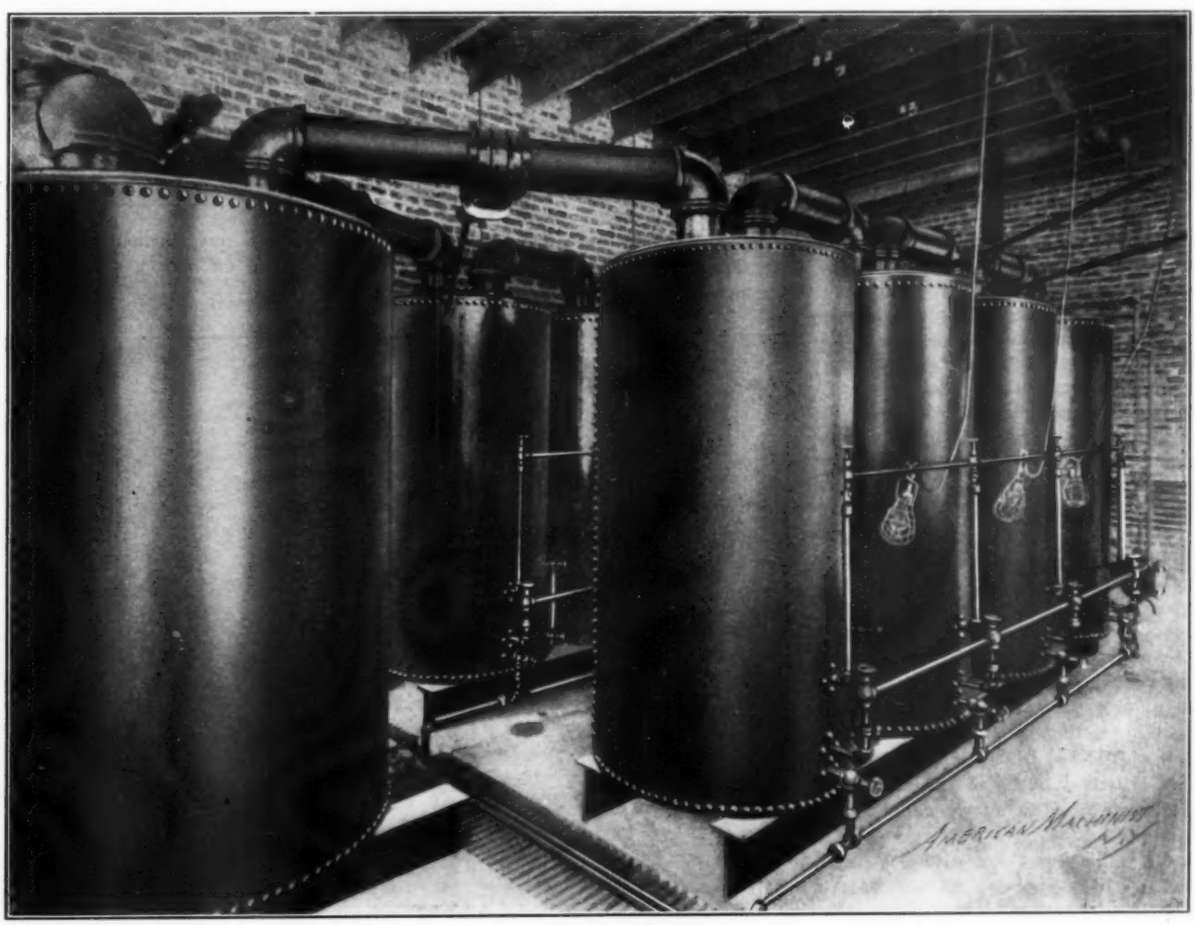


FIG. 20. A BLACKSMITH-SHOP GAS PLANT.

FIG. 21. A GAS-FIRED FORGE.

him to term himself an engineer as he increases in years, by filling in the blank formed through not being constantly in the shop, *i. e.*, the practical side of engineering. If he thoroughly digests the matter in the paper he keeps himself conversant with the latest and quickest methods of doing and getting out work, and with the latest designs and mechanical movements continually being given birth in the world of engineering. It stands to reason that a draftsman, whose work is chiefly in the theoretical line, even though he may have been through the works, requires something to keep his ideas up to date in the many items pertaining to his profession. There is also just a pinch of engineering formula which is very useful to the average draftsman; but for those in the jig trade there is something more —useful designs of jigs, which are minutely described and cannot fail to be of service.

But to return to the advertisements. These, as a rule, show the latest and very best designs, and if required the engravings could be cut out and classified, making an interesting collection of the very best machines and articles on the market, which collection ought to be of considerable value to the draftsman in his work.

Again, if one does not have a general knowledge of engineering, he feels at sea when conversing with a fellow acquaintance with another branch; there is an excuse, as engineering covers such a wide area. Much general knowledge, however, can be obtained from advertisements.

One more thing I would like to mention is the sending of circulars and catalogues by firms to draftsmen who have the cheek (?) to ask for them. Generally it takes a draftsman all his time to obtain such things, which I think is a mistake, as in many cases it rests with the draftsman as to whose make he uses out of his own line. TROCHEE.

England.

Calculating Cone-Pulley Speeds.

Writing on this subject at page 119, Mr. Millar mentions the fact that it is the correct practice to use the full cone range before altering the counter-speeds. While quite agreeing with this, I think that there is a better reason for arranging the cone and counter-speeds thus than the one he gives, viz., greater lap for the belt. As Mr. Millar says, when a cone is designed as above, the small step becomes much larger than when arranged for change of counter-speeds between the steps; but it is clear that by increasing the diameter of the small step, the slowest belt speed is also increased, thereby making the smallest horse-power supplied to the machine as great as possible. This, I believe, is the real reason for designing the cones and counter-speeds as stated. W. OWEN.

Salford, England.

Washing Buffing Wheels.

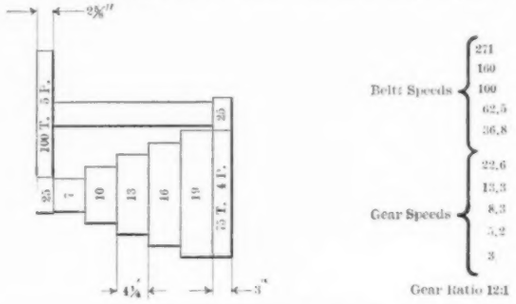
Reading the articles by H. A. Dudgeon and C. H. Norton, on "A Washing Machine for Buffing Wheels," reminds me of the way we used to remove the old emery and glue from the wheels at a razor shop several years ago. We took mud from the trough under the grindstones and smeared it ¼ to ⅜ inch thick over the face of the wheel, being careful not to have any stay on the side, as the moisture would loosen the leather cover of the wheel. The wheel would then be hung up, or rested on its side, until the moisture would loosen the glue and emery, when it could be easily scraped off with a sharp piece of steel. D. T. FLETCHER.

FIG. 22. A LARGE GAS-FIRED FORGE.

Analysis of Some Engine-Lathe Drives.

Herewith is a diagram of a 30-inch lathe headstock showing the dimensions of the cone pulley and gearing. I believe it will further support my claim that the quill pinion is the weak point in the ordinary lathe drive. This lathe was built by one of the largest concerns in this country. It has been running for sixteen years, being used principally on cast-iron rolls about 12 inches in diameter.

I had the job of applying a motor to this machine and while making measurements and sketches necessary for laying out the motor drive, I got acquainted with the machinist operating this tool. He has been running it for fourteen years, during which time two of the quill pinions have broken. The second one broke about three years ago, and after this happened the quill was supplied with a phosphor bronze pinion, which has been in constant use since. The gray-iron pinion broke by the strain of the cut and not by any accidental cause. The cone pinion of 25 teeth 5 pitch is the original one furnished with this machine and does not now show so much wear as the phosphor bronze pinion on the back-gear quill.



Lbs. Pull Cone Pinion, Belt on 19″ Step, 60 Lbs. 1″ Width	912
" " " " " " 16″ " " " " "	768
" " " " " " 13″ " " " " "	624
" " " " " " 10″ " " " " "	480
" " " " " " 7″ " " " " "	336

Max. Pull on Cone allowing 60 Lbs. per Inch of Belt	912
Lewis Formula for Cone Pinion	1279
Max. Pull on Quill Pinion	2920
Lewis Formula for Quill Pinion	1827

American Machinist

A 30-INCH LATHE HEAD.

In Mr. Fish's criticism at page 86 of my article above referred to, he assumes that since the face gear runs one-third as fast as the cone pinion that the strength of the face gear should be three times as great as that of the cone pinion. This is not in accordance with the formula and practice has proved it unsafe. The Lewis formula assumes a safe working load for gray iron of 8,000 pounds when the travel of teeth is 100 feet per minute or less. As will be seen by referring to the table, the cone-pinion and face-gear teeth travel less than 100 feet per minute when the belt is on the largest step of the cone—a condition which gives the greatest leverage. As the speed of the cone-pinion teeth increases the load against them diminishes, which fact is also clearly shown in the table.

It was not my object when pointing out these alleged faults in lathe design to state anything but the facts as I found them, and when I stated that the teeth were broken in a quill pinion that is what existed. Neither was it my purpose to inflict involved formulas. It is only the simpler ones that I am able to fathom, and hence doubtless I am rather enthusiastic when I come across one which agrees so well with practice as the one referred to.

I fully agree with Mr. Fish that after many years of use the majority of lathes retain their full sets of teeth. I am pretty sure this condition exists in most polytechnic institutes, where not one lathe in twenty is run to its full capacity, and I am reasonably certain that Mr. Fish never saw a 14-inch lathe roughing, say, Corliss engine valves, yet this size lathe will swing the job.

Mr. Fish tells us that the engine lathe up to the advent of high-speed steels was more than any other tool a matter of evolution, yet he concludes his article by citing a case in which the apron gears and rack were not half as strong as they should have been. Now, if the cone-pinion repairs have been the means of making this part twice as strong as it should be, why hasn't evolution struck the apron gears?

Maybe I am like the Scotchman who in the heat of argument said, "I am willing to be convinced, but you can't convince me."

ART ISAN.

Some Reasons Why Good Men are Scarce.

There is a great deal of truth in the article at page 175 on the subject given above and it applies not only to shopmen but to draftsmen also. I have seen draftsmen working day after day at the board simply because they will not push themselves forward to obtain what I should term their rights. They are experts in their trade, but seem to dislike to take any responsibility through the lack of self-confidence. They have no ambition, being perfectly satisfied to take life easily and not be troubled with the petty trials, not to mention worry which attend responsibility and taking charge. At least these are the only reasons which can be assigned for such conduct; some men not being able to see that with taking a better position and therefore earning a higher salary they are lessening the time to when they can retire on their earnings.

One case I know of personally is of a man who had had very good training, both technical and practical. He was one of the most efficient men in his line of engineering, having worked for some of the best firms in the country, but would not take up the responsibilities of chief because of the before-mentioned reason—lack of self-confidence. He could not say he had not had the chance because he had actually been asked to take such a position by several of the firms. Another most peculiar trait of this man was that he would not stay at one place more than three or four years, continually roving about. I will admit that this man was an exceptional case, but I have recounted the anecdote so that if any of your readers have the ability and knowledge to take charge of a responsible position they should realize that they ought not to rest until they have attained such.

I should also like to impress upon readers the advisability of being ambitious. I do not agree with anyone undertaking work which is too much for him and for which he has had no previous experience, but I think there is nothing so inducive to the obtainment of a good position as plenty of self-confidence, which enables one to take over responsibility or work requiring a knowledge of higher technics and a great deal of hard work before he is, to use a favorite phrase, on the top of his job.

As regards the question of technical graduates, my opinion is that on the whole they do not make the best of their opportunities, and for this reason: Many

are men who are possessed of plenty of money and take up engineering only to pass the time away and to increase their pocket money. The self-made man takes to engineering to earn his living, therefore who would give more heart to his work? The self-made man, of course, because he knows he cannot afford to let his chances go by. There are exceptions to every rule, as there are plenty of technical graduates with higher ambitions than a self-made man often dreams of. One more reason I think self-made men are preferable as draftsmen is, that in the majority of cases they have obtained their positions only by overcoming many obstacles and passing through many difficulties to obtain the knowledge which is an absolute necessity. This is very often accomplished under the most trying circumstances, such as hard study after a hard day's work, whereas the technical graduate's work is to study. Such hardships make a man better able to withstand the rebuffs he encounters in his upward struggle for supremacy, creating a spirit in him which is thoroughly rooted by the time he has attained his ambition, when it is then of great service to him in mastering difficult problems and preventing him from being easily discouraged.

As a concluding remark I should like to impress more forcibly on those who have ambitions that these can be attained only by hard work. No one need say they have no opportunities, as they are not possessed of any wealth; Andrew Carnegie is reported to have said that poverty was one of the essentials to become great. But there is one thing above all others I wish to warn young men against, and that is, they should not go to the extreme and do too much work, which is detrimental to the health, bearing in mind that the way to success is perfect health and great staying powers, as well as knowledge.

TROCHEE.

C——, England.

Solid Versus Split Machine-Tool Spindle Bearings.

I must say that I have a decided preference for solid taper bearings for the spindles of machine tools. The vertical miller I use had, originally, a spindle bearing consisting of a split bronze sleeve lined with babbitt metal, and after it had been used a couple of years it seemed impossible to keep it a good fit in the bearing without causing trouble by heating.

Having a Stark bench lathe that I had used for four years, and knowing how little attention the bearings had required in that length of time, I made a spindle on the same plan for the miller. I made the spindle and boxes of soft steel, case-hardened, and ground them and found that the spindle not only gave no trouble but that I could use a larger mill without chatter than I could with the original spindle.

Again, on the bench lathe I use a forming tool on some bronze knobs, taking a cut 1¼ inches wide without any chatter; but if I try a trick like that on a 13-inch engine lathe I have that is in good condition, and has a much larger spindle than the bench lathe but fitted with split bronze bearings, the howl that the engine lathe will put up at being forced to do such work would call out the police reserves.

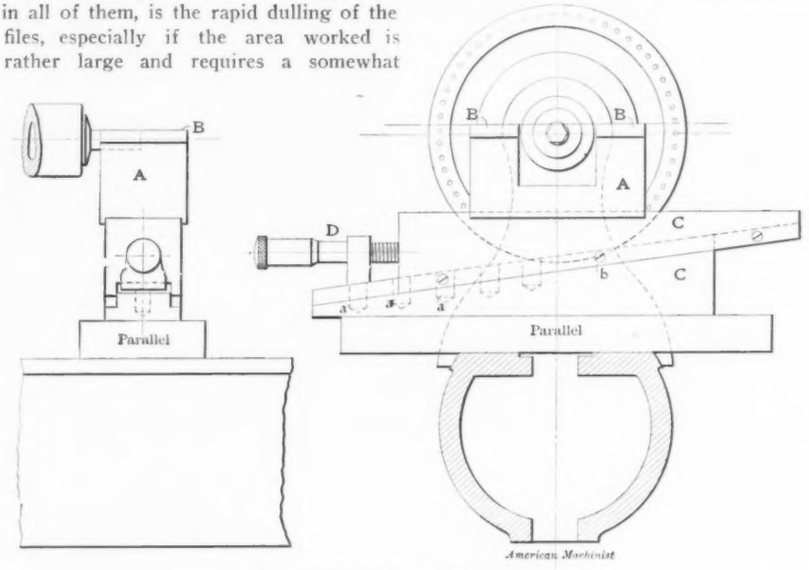
F. L. NICHOLS.

Filing Fixtures.

The article on filing fixtures by William Doran, which appeared at page 867, Part 1, was interesting to me, as no doubt it was to others; and probably many mechanics were surprised to learn of the existence of tools of this kind in manufacturing establishments. I first saw such tools in use a few years ago, and I must confess that I was surprised at their efficiency. The only discouraging feature of those I saw, and I believe it is present in all of them, is the rapid dulling of the files, especially if the area worked is rather large and requires a somewhat heavy pressure on the file to hold it to its cut. The hardened guides or gage plates, being of about the same degree of hardness, soon take the keen edge off the file teeth, unless great care is exercised to keep off of these gage plates as far as possible; but in the hands of an experienced filer the files last a reasonable length of time and the superior work produced seems to warrant the little extra outlay on files. Another point is the selection of a file that is quite straight or the work will likely come concave or convex, depending upon the convexity or concavity of the file, as the case may be.

I show herewith a device that is to do work of similar nature, but which is used on the bench lathe or any lathe for making punches with flat sides, or squaring heads on taps, etc. Square, hexagon or other work of the kind that would otherwise have to be taken to the milling machine can, with this device, be finished, after turning, and before removing from the chuck with the assurance that it is as true as it is possible to get it; the same accuracy could be attained only by the exercise of great care if the transfer were to be made from the lathe to the milling machine.

Referring to the sketch, *A* is a gray-iron block made to the shape shown, with an opening between the jaws of, say, 2 inches, which will allow fairly large pieces to be admitted between them. The top and bottom of *A* are finished parallel and the top is faced with the hardened steel plates *B*. *C C* form an adjustable parallel which is a necessary part of the outfit, unless other means are at hand for securing vertical adjustment of block *A*. This parallel may or may not be provided with the micrometer adjustment at *D*, but there are obvious advantages with the micrometer. The taper of the pieces is optional with the tool-maker, except when the micrometer adjustment is required, when it becomes necessary to adopt a taper that will allow the micrometer screw to be made with a pitch within the capacity of the lathe and give a whole number of graduations on the barrel. The outfit shown here has the pieces *C* planed with a 1½-inch-per-foot taper, and the micrometer screw cut 12½ threads per inch. The micrometer barrel is divided into tenths, so that a 1-inch movement of one-half of the parallel upon the other gives a vertical movement of ⅛ inch, and with the micrometer screw each sub-division on the barrel gives 0.001 inch. The micrometer head can be moved from one hole *a* to another, as the case may require. These holes *a a a* are spaced 1 inch apart on a line parallel with the base, since the micrometer measures the same way. The small screws *b* are for tightening the parallels when necessary to prevent them from moving along each other. An improvement on these screws would be a small thumb-screw in the center.



FILING FIXTURE FOR THE LATHE.

The sketch shows a piece having a hexagon head, filed thereon in a small bench lathe, and brings out clearly enough the object and principle of the device. We have used it a great deal in punch and experimental work, special tool-making, etc. W. M. Fox.

Bevel Gear Formulas.

In the article at page 487, Vol. 28, Part 1, by Mr. Edgar, one point about bevel gears that has a shop use is overlooked. This is in connection with bevel gears with axes not at right angles.

The way this problem usually confronts a designer is with the angle between the shafts given and either the velocity ratio given or the diameters of the two gears, which answers the same purpose. With the conditions given in this way the designer is left to cut and try on paper, though after he has found his result he can prove it by the formulas given.

With the idea of helping the designer in this predicament, I offer the following solution: In Fig. 1 the axes are shown to be at an acute angle, α being the angle of the shafts, ϕ the angle of the pitch cone of one of the gears, whose radius is R, and r the radius of the other gear. It will be evident that the sum of the angles of the two gears will be equal to α, so we need only concern ourselves with the value of ϕ for different ratios between r and R. Complete the figure as shown

Then $\tan.\ \phi = \dfrac{R}{a}$

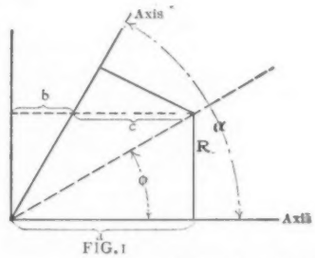


FIG. 1

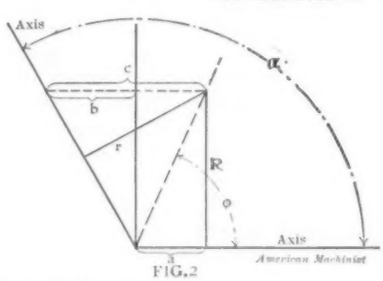


FIG. 2

BEVEL GEARS WITH SHAFTS AT OBLIQUE ANGLES.

$$a = c + b \qquad c = \frac{r}{\sin.\alpha} \qquad b = \frac{R}{\tan.\alpha}$$

$$\therefore \tan.\ \phi = \frac{R}{\frac{r}{\sin.\alpha} + \frac{R}{\tan.\alpha}}$$

$$= \frac{1}{\frac{r}{R\ \sin.\alpha} + \frac{1}{\tan.\alpha}}$$

$$\text{or cotan.}\alpha = \frac{r}{R}\,\text{cosec.}\ \alpha + \text{cotan.}\alpha$$

For obtuse angles see Fig. 2, which will be seen to be practically the same as Fig. 1. In this case

$$\tan.\phi = \frac{R}{a}, \text{ but } a = c - b.$$

$$c = \frac{r}{\sin.(180^\circ - \alpha)}, \quad b = R\tan.(\alpha - 90)$$

$$\therefore \tan.\phi = \frac{R}{\frac{r}{\sin.180^\circ - \alpha} - R\tan.(\alpha - 90^\circ)}$$

Divide by R and simplify, giving cotan. $\phi =$

$$\frac{r}{R}\,\text{cosec.}(180^\circ - \alpha) - \tan.(\alpha - 90^\circ)$$

The use of this latter formula is bothersome at times from the right-hand side having a negative value. This shows that the pitch line inclines to the left of the vertical, as Fig. 2 is drawn, so that if this angle is to be figured from the horizontal on the right-hand side, the angle obtained must be subtracted from 180 degrees before being used. E. H. Fish.

Two Methods of Machining Crossheads.

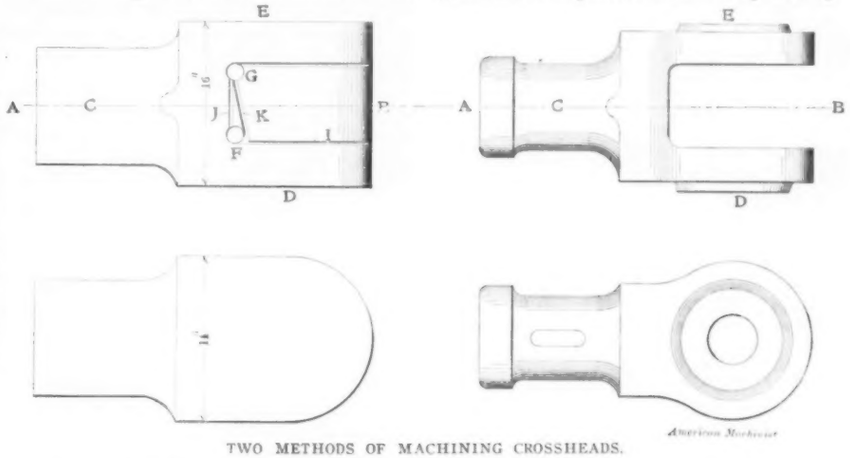
Some time ago there cropped up under my notice the way in which two different shops in the same town set about the job of machining a steel crosshead from the solid forging. Firm No. 1 centered the forging at A and B and turned the shank C to size; it was then taken to the planer, fixed in centers, packed up secure from the table, and planed to the required thickness on D and E. Then it was taken to the radial drill and two holes F and G 2½ inches diameter drilled through. Then in the large slotter a square-nose tool ⅝ inch wide cut the slot H into the hole G, and likewise at the opposite side I into the hole F. The work was then parted off from G to F by the cut J, and afterward finished on the slotter to shape. The hole for the crosshead pin shown at D was bored in the drilling machine, and the pin shrunk in. The lot were then swung in the lathe centers and the two planed faces D and E finished as shown.

Firm No. 2 proceeded in an entirely different manner by centering the forging at D and E and finishing those two faces in the lathe first, afterward centering it at A and B, some skill being required to get these two centers exactly square with D and E. It was then turned to size on the shank C, then taken to the radial drill and one hole only drilled at G. The band saw was used to take the cut H into the hole G, and the crosshead then turned round 90 degrees, and a saw cut taken in a slanting direction, as at K. After the saw was backed out another cut was taken up as at I until it reached K, the middle piece then being free to be pulled out. The crosshead was then taken to the slotter for the first time and finished off to shape.

The method followed by Firm No. 1 took about 20 per cent. more time, but a much more expensive man is required by Firm No. 2 to turn the faces D and E, whereas a boy can plane them for Firm No. 1. The greatest saving is effected by Firm No. 2 sawing the center out, as there is only one hole drilled and sawing is much quicker than slotting, but it was found after long experience that the forging in question was one of the most difficult pieces to saw they ever had to deal with, due to the strains set up in the forging when cooling. As soon as the saw had got a little way in, wedges had to be driven into the saw cut to wedge the sides apart to give the saw clearance; otherwise it would soon stick fast and no amount of persuasion would get the saw out without breaking—no matter how much "set" it was given. This difficulty always arises and it sometimes takes several hours to get the saw out after sawing the grooves H and K, though sometimes the saw comes out without any trouble.

Summing both methods up, No. 2 is the quickest and best under ordinary conditions. Corliss.

England.



TWO METHODS OF MACHINING CROSSHEADS.

A young man, writing us regarding the position he holds, which is one in which he says he is growing lazy, remarks: "If I don't get out pretty soon I'll live and die here, and it will be pretty hard to tell when life ends and death begins."

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Contents.

	PAGE
Methods of a New England Milling Machine Establishment	411
Newspaper Railroading	414
Manganese in Gray Iron	414
Producing High Vacua	415
A Peculiar Break of a Bar of Steel	415
A New Method of Driving Floor Boring Machines	416
The New Plant of the B. F. Sturtevant Company at Hyde Park, Mass	418
College Shop Experience—IV	422
The Use of Fuel Oil on the Pacific Coast—II	426
Letters to the Editor: Dimensions on Drawings....Some Questions in Connection with Tool Design....Analysis of Some Engine-Lathe Drives	429-435
The "Bennington" Disaster	436
Charging Off for Depreciation	436
The Centennial of Steam Navigation	437
Machine Tool Builders' Convention	437
The "Get Together" Principle in a Factory Organization	437
Metal-Sawing Machines	439
New Three-Wire Generator	439
Personal	440
New Publications	440
A Special Job of Worm-Wheel Hobbing	440
A Combined Payroll and Cost Sheet —Loose-leaf Accounting System	441

The "Bennington" Disaster.

At this writing the trial by court-martial of Commander Lucien Young, of the gunboat "Bennington," on charges that have been preferred against him in accordance with Secretary Bonaparte's order, is going on at the Mare Island navy yard. The charges against Commander Young are, in substance, "neglect of duty"; but it seems to us that the real charge has not yet been brought, and we fear will not be brought. The real charge is that the Navy Department, which requires that a lot of high-class engineering work shall be done, has no corps of engineers to do this work. Men are placed in charge of machinery, which machinery they do not understand, and in which they take no interest. The men under them have no authority, are not placed in positions which enable them to respect themselves nor to command the respect of others, and, in short, every well-organized and well-established principle of the successful conduct of engineering work is set at naught. The entire organization and the status of those who are depended upon to do the engineering work are wrong and must be radically changed before things can possibly be put upon a satisfactory basis. That is the real charge; but whether it should be brought against the Navy Department, against the line officers' clique, or against Congress, we do not know. We are quite certain, however, that sooner or later this condition of affairs will have to be remedied.

Our contemporary, *Power*, commenting upon the "Bennington" disaster, says:

"There must be somebody in responsible charge of the steam apparatus and machinery who has been brought up on a diet of coal dust, boiler scale, iron rust and lubricating oil, instead of dignity, gold lace and differential calculus; somebody who will be more punctilious about his safety valves blowing off than about the jackies saluting as he passes; somebody who knows the tortuous way through a 9x11 manhole, and among the braces and stays, and how to keep his head and breath and patience in a stifling back-connection, as well as the other fellow knows navigation and tactics and international etiquette. His the duty to have the vessel ready at any moment, without excuse or hesitation, to answer the signal from the bridge, as the muscle responds to the brain. He should have entire executive charge in his department, be held accountable for results, and receive compensation and official distinction commensurate with the position which he occupies and the duties he is called upon to perform.

"A man who adds to the practical knowledge required to manage the complicated organism of a man-of-war the executive ability to maintain efficiency and discipline in a department embracing some 40 per cent. of the personnel of the ship should not be considered and rated somewhat as a cook is in a camp. There is no reason why the engineering department of the Navy should not fulfil the ideal of the American people, if the American people will put practical men in charge and make the career honorable and lucrative enough to attract and retain as good men as does the merchant marine."

It is as certain as anything can be that until conditions are such that this state of affairs is secured there will be no permanently satisfactory condition of things in the United States Navy, and those in authority may as well make up their minds to that fact.

Charging off for Depreciation.

The issue of the *Daily Consular and Trade Reports* for September 16 is partly devoted to municipal ownership, and tells of successes and failures in England. There seems, however, to be no real failure noted in the sense that municipal ownership has in any case been given up; but there have been some qualifications of success. The principal one mentioned is due to the fact that the officials in charge of a street railway system in Sheffield have not charged sufficiently for depreciation of value of plant, and are now confronted with the problem of renewing a portion of their plant, and with no funds to do it with. Such mistakes are very common among manufacturers, and until within a few years past were much more common than they now are. We suppose that those who administer municipally-owned plants will, some of them, have to learn this thing, as manufacturers have had to learn it, by bitter experience. Of course, there are those ultra-conservative souls who can see no good in anything which is new to them, who are loudly crying that failure to charge a sufficient amount for depreciation of plants is a peculiarity of municipally-administered undertakings. Anyone at all familiar with the industrial world knows that this is by no means true, but that it is a besetting sin of those who conduct industrial operations and who wish to make the best possible showing, or to pay the greatest possible dividends, or who simply don't know any better. Failure to charge off sufficient for depreciation in value of plant has been the cause of much ruinous competition between manufacturers in the past, is still a fruitful cause of it, and we suppose will continue to be for some time to come; although manufacturers are being educated up to the folly of such a course.

There is perhaps greater temptation to err in this respect in the case of municipally-owned plants, because when the time comes for renewing the plant a vote of money, or the issue of municipal bonds, is expected to keep things going.

But, on the other hand, there should in one sense be less temptation, because municipal enterprises are not usually ex-

posed to the rigors of competition and can fix the prices for service at what seems necessary to defray properly determined costs. Failure to follow this course seems to have been the mistake made by the managers of the Sheffield roads, who were ambitious to give the best service at a lower price than was paid elsewhere, and did so, against the protest, it is interesting to note, of Sir Joseph Jonas, the Lord Mayor of Sheffield, a manufacturer, member of the firm of Jonas & Culver, makers of certain well-known steels, who warned them that they were pursuing an unwise course. Not unlikely he has warned fellow-manufacturers against making the same mistake in their own business accounts and with about equal success.

The Centennial of Steam Navigation.

It will be remembered that at the Scranton meeting of the American Society of Mechanical Engineers, the Society received an invitation to co-operate with persons who are arranging for a celebration of the beginning of steam navigation on the Hudson river. In furtherance of the plan for such a celebration a meeting was recently held in New York, at the rooms of the Board of Trade and Transportation, at which prominent men were present, interested in steam navigation in various ways, including Rear Admiral George W. Melville. Suggestions were made that there should be erected a monumental water gate, as a ceremonial entrance place to the city of New York. It was also proposed that there should be processions of various kinds, including one to consist of fac-similes of vessels, showing the progress of steam navigation since Fulton's time. Of course, these features may not be a part of the celebration, but it is evident that those who have the matter in charge have large ambition, and that the celebration, which is to take place in 1907, will be upon a very grand scale.

Machine Tool Builders' Convention.

The annual convention of the National Association of Machine Tool Builders will be held in this city, October 16 and 17. The headquarters will be at the Hoffman House.

The behavior of the "Bremen," of the North German Lloyd Company, proves what will be new to most persons—that is that the breaking of one of the propeller shafts of a twin-screw vessel may immediately disable the vessel entirely; that is to say, prevent the use of either propeller. It seems that in this case one of the shafts broke and shifted aft in such a way that its propeller fouled the propeller on the other shaft, and neither of them could be used, and the vessel, which would have been generally supposed to be proof against a misfortune of that kind, had to be ignominiously towed into port at Halifax.

The "Get Together" Principle in a Factory Organization.

BY H. F. J. PORTER, M. E.

It is customary for men who possess interests in common to come together from time to time, to discuss ways and means of keeping those interests coordinated and of improving their condition. Such is the recognized method of handling affairs; nations, communities, business organizations, large and small, conform to it. Parliaments, congresses, assemblies, committees are the *modus operandi*. The system is simply a recognition of the law of cause and effect. Focus the available composite intelligence on a problem and a solution follows. And the better the intelligence is adapted to approach the subject by a thorough knowledge of its details, the more satisfactory to all concerned will be the decision arrived at.

I have watched the results of annual meetings of boards of directors, monthly meetings of executive committees, weekly meetings of officers, all of which are included in the program of management of every well-organized enterprise. I have occasionally found a concern where the manager, at stated intervals, gathered the superintendents of his shops together for a conference, and have also found a superintendent who would summon his foremen to discuss some matter on which he needed light, which they alone could provide. But I have noted that, as a general rule, it is customary to regard the rank and file of an organization as possessing no intelligence worth taking into account. The employees are not supposed to think, but are expected simply to carry out the work that someone else has planned for them. It has seemed logical to me, however, to presume that if results sought for were obtainable through the principle of "getting together" the more representative element in an organization, a well-defined system of regularly getting together those farther down the ranks, for the purpose of considering improvement in methods and processes in which they are specialists, would be productive of corresponding, or at least proportional, benefit.

As far back as twenty years ago the practicability of this idea was demonstrated on a small scale at Columbia University, where I was then superintendent of buildings and grounds, and held weekly meetings of the janitorial forces, together with those responsible for the heating, ventilating and lighting of the buildings. One man from each building was given a half day off each week, and was commissioned to visit other institutions in the city and to report at the meeting following any improvements over current practice at the university which came to his observation.

The effect of this means of developing the powers of observation of the men and increasing their interest in their work was so apparent in the improvements which took place in their methods of work that I have since then introduced these principles in my systems of management, wherever practicable, and have been well satisfied with the result in every instance.

A PRACTICAL EXAMPLE.

As an illustration, may be cited a recent example where a small manufacturing concern had under old methods twice failed to market its product. Having been called upon to reorganize the business, the "get together" policy was here instituted to a fuller extent than I had previously attempted. Each employee, as soon as he was engaged, was fully and carefully instructed in the details of his duties and was requested to inquire at once regarding any matter which might arise about which he was uncertain. He also had the importance of his duties, no matter how insignificant they appeared to be, impressed upon him, with the statement that if they had not been of sufficient importance to be performed, and in the right manner, he would not have been employed to do them. He was then instructed to exert his originative powers regarding improvements in his work as his experience might suggest, with the injunction that he would be expected to bring the results of his reflections to conferences of his peers which would be held at stated intervals.

As the result of the working out of this policy, the product was perfected so as to be satisfactory to the purchasing public, the processes of manufacture were simplified, their cost correspondingly reduced, and the company was put upon a paying basis within a very few months, so that at the end of the fiscal year it realized a fair return upon the capital invested.

An editorial and chart appeared in a recent issue of the monthly "Bulletin," the official organ of the company. This chart shows the development of the business during the period beginning one month after I took charge and ending two months after my services terminated. The sales per month increased during that time over 800 per cent. From the editorial, which was entitled "A Chart of Progress," I quote as follows:

"The wisdom of our present policy . . . is clearly demonstrated by the accompanying sales curve. This policy, which had its beginning on January 1, 1904, and which is now eighteen months old, has resulted in a business record which, to say the least, is very encouraging to us. . . . It is seen that the curve has a decided upward trend, which augurs well for the future. . . ."

It had been a tradition in the company that the summer months were the "dead season." As it became apparent that a corps of efficient salesmen was needed to push the business, a salesman's school was

established in the factory under the charge of a technical school graduate. A sales organization was recruited during the summer of 1904, and its efficiency began to show its effect in the fall, as is reflected by the curve. This efficiency has since been maintained so that during the recent summer months there was no dead season. The slight depression in the curve in December, January and February is due to the fact that those were short months, the last week in December and the first week in January being holiday weeks, and February having holidays, as well as fewer days in its calendar than the other months.

So much inquiry by managers and others similarly interested who visited the works was evoked regarding the details of the system that had brought about this result that I have consented to give a brief description of its operation for the benefit of those who may be struggling with problems in organization which do not yield readily to the light that has so far been shed upon them.

A CHART.

In the first place, a chart was evolved for the purpose of locating every individual in the company in his proper place and of letting each one see exactly where everyone else stood relatively to himself. A chart of this kind is invaluable in every well-organized establishment, and after it is made and posted throughout the works there is never any misunderstanding as to definition of authority and responsibility, it being understood that the possession of one of these requirements always entails the accompaniment of the other.

SALES CURVES.

Man is a social being, and it is by encouraging rather than repressing his inclinations that his willing efforts are aroused and his best work obtained. It is conceded that where people get together for a common purpose and with a will to accomplish something, a way for successful accomplishment is generally found. The object of getting together is, of course, to secure a concentration of different points of view and to stimulate discussion which will lead to co-ordination of ideas and co-operation of effort. In order to render such co-operation possible, however, the opportunity to work together for that purpose must be offered—the machinery necessary for collaboration must be furnished.

SYSTEMATIC CONFERENCE.

It was desirable in the development of the system which I had planned to establish the principle of getting together those who were engaged in similar operations for the purpose of arousing discussion on subjects with which they were familiar and of making use of the ideas evoked.

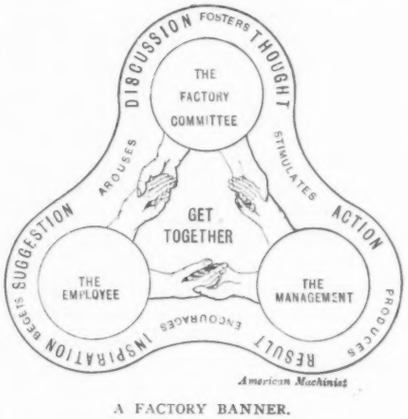
In order to introduce such a system into an organization whose intelligence had not previously been realized or recognized by the management, it became necessary to bring all the individuals concerned to a thorough understanding of what the management had in mind and to enlist their confidence and interest in the proposed plan.

To bring about these conditions, a meeting of all the employees of the company was called to take place one day at noon, and there I announced the desire of the company to change its policy of management to one in which all the employees should have a voice. The employees were requested to elect a factory committee, with representatives from the office, the selling organization, the factory operatives and the foremen. Of this committee the superintendent, representing the management, would be permanent chairman, while the term of service of each of the other members would be six months, so arranged that one member would retire and a new one take his place every month. This committee would act in a recommendatory manner to the management on all matters which would come automatically to it through a suggestion system as follows:

1. The Collection of Suggestions.—The employees were privileged to suggest any improvement of product, process or method which they might devise; also to recommend improvements in their working conditions or for their comfort. Questions of wages or of fairness of treatment by their foremen were first to be brought to the attention of the superintendent. All communications were to be signed and dropped into locked boxes, one of which was placed in the office and one in each department of the factory, and collections were to be made periodically by a confidential correspondence clerk in the main office, who would give to each communication a number, and file it for future reference. A copy without the writer's name was to be sent to the factory committee, which, unaware of the personality of its authorship, would pass upon it purely upon its merits and the author would be advised of its disposal through the minutes of the committee meetings, which would be posted on the official bulletin boards in the office and factory and supplied to the sales offices about the country through the columns of a typewritten "Journal," which daily informed everyone in the organization regarding the principal occurrences of interest in the company. Such suggestions as could not be passed upon promptly by the committee would be referred, with a request for a report on their practicability, to the department which they affected.

2. The Reference of Suggestions for Departmental Report.—Each foreman was instructed to call the employees in his department together, for a few moments at closing time once a week, to consider such suggestions as might be referred to him by the factory committee, and further to discuss any ideas which might be raised at the time leading to improvement in facilities for doing work or in comfort and conditions.

3. Further Conference on Suggestions Before Recommendation.—The superintendent was instructed to have the various foremen meet in his office every Saturday afternoon after closing time to talk over such matters as had been considered at their departmental meetings, above mentioned, and also to discuss questions of factory management, as well as to devise ways of working more closely together.,



A FACTORY BANNER.

4. Final Recommendation Regarding Suggestions.—The superintendent would then report, at the next weekly factory committee meeting on Tuesday morning, regarding the various suggestions which had been referred to the departments under his control. All suggestions which were approved of as worthy of adoption were referred to the general manager with a recommendation to that effect. A schedule of awards for suggestions was formulated to induce their production and in payment for value received.

5. Decision Regarding Suggestions.—Every Wednesday afternoon representatives of the sales, development, production and financial departments came together at a "factory staff" meeting to discuss and finally pass upon the suggestions favorably reported to the general manager by the factory committee. This meeting also considered general complaints received from the public through the salesmen regarding the product, and to devise ways

and means of overcoming troubles and improving designs. Such of the latter as required expert consideration were referred to the factory committee, to be handled in routine form.

APPOINTED CONFERENCES.

Every month each district sales manager, of which there were ten, located in the principal cities between Boston and San Francisco, gathered his salesmen together to receive their reports on their respective territories and to give them encouragement and advice. The minutes of the meetings were promptly forwarded to the general sales manager at the home office. From a perusal of them he could obtain a very clear idea of how things were going and determine the necessity of visiting personally or sending help to a delinquent office. Twice a year the district sales managers met at the factory with the development and production departments, to assist the general sales agent in formulating a sales policy for the coming year.

Every Monday morning the heads of the departments composing an advisory board met the general manager in his office to discuss matters of inter-departmental and commercial policy.

Once a month the first vice-president and the secretary and treasurer, representing the board of directors, met with the general manager, the chief of the development department, the superintendent of production, the general sales manager and the auditor, to review the work of the month from a financial standpoint, and to consider such suggestions as might influence the commercial policy.

LUNCH CLUB.

A lunch club was formed, where luncheon was served at a more reasonable figure than could be obtained elsewhere, and at noon daily there assembled representatives of all the departments to establish close social relations and discuss matters of interest to the company in a manner more free from formality than might exist in the factory. Separate lunch rooms for the men and women factory operatives were provided in the factory building, where, after the noon-day meal, they could discuss independently matters of interest to themselves.

In fact, discussion of the company's interests from every point of view was encouraged and channels were arranged so that the results were sure of eventually arriving where they would be conserved. Underlying all this effort was the search for truth and a determination to hold fast to that which was good.

STIMULATING THE INTEREST OF EMPLOYEES.

Every employee was made to feel that he would obtain full credit and ample payment for his contributions, and these assurances, in connection with the publicity given in the *Journal* to the names of those whose suggestions were accepted, imbued them with pride in the part they were taking in advancing the business of the company and incited them to further effort in the same direction.

The employees adopted the motto "Get together," and framed a banner emblematic of the principles involved in that policy. This is shown in the accompanying sketch, and an outline of it they wore as a badge of membership in the organization.

The ideas embodied in the banner are that the employee and management together support the factory committee, and that the three, hand-in-hand, govern the fortunes of the enterprise. The interrelations of these three bodies are shown in the following phrases, indicating the "get-together" principle and how the management and employees are brought in touch with each other through the factory committee:

On the part of the employee—Inspiration begets suggestion.

Between employee and factory committee—Suggestion arouses discussion.

On the part of the factory committee—Discussion fosters thought.

Between factory committee and management—Thought stimulates action.

On the part of the management—Action produces result.

Between management and employee—Result encourages inspiration.

In order that the general manager might devote his undivided attention every day to the interests of each department, and that the time of those in charge of the departments might at the same time be conserved, a schedule of appointments was made for each day. The head of each department collected, and arranged in advance of his time of appointment, all matters intended for the consideration of the general manager, and brought them to him at his office at the appointed time. If more time was necessary for the consideration of any subject than was allowed by the schedule, an hour was set apart later in the day for such overflow work.

By this arrangement the head of each department was assured of a daily uninterrupted audience, and could arrange his time and affairs accordingly. On one day of each week the appointment was kept in the office of the department head, instead of that of the general manager.

The appointments of heads of co-related departments came in sequence, so that one consultation could overlap into the next if necessary, and frequently when the interests of other departments were affected by matters under consideration at any time, their respective heads were called in for advice.

The factory closed at 5.30 P. M., and from then until 6 o'clock the general manager was in his office and ready to receive individual employees on personal matters, the matron and others engaged in sociological or welfare work in the factory and representatives of such social and mutual-aid organizations as naturally developed in an atmosphere of such close association.

This schedule of appointments was posted on the official bulletin boards, and everyone in the organization knew at all times how the general manager was occupied and when he could be seen.

Thus the general manager kept his hand upon the mechanism which was guiding the policy of operation. But the life instilled into the organization by the system of "getting together" was the impelling force ever present, with its potency not only to develop and make use of the intelligence of all concerned, but to uplift and improve the individual in the organization.

PRINCIPLES, NOT PERSONS.

Apart from the stimulus and enthusiasm brought about by co-operation, the endeavor was to have a principle or ideal govern rather than a person. The policy of management thus became the direct ruler, while the person in charge at any point merely interpreted that policy when a question arose demanding attention. So clearly defined becomes the spirit of such a policy that any departure from it is at once instinctively felt and is righted by the resistance it encounters. It was this spirit, together with the concentrated effort on the part of the whole organization to do things better than they had been done, which brought the enterprise to a paying basis. This accomplishment was most gratifying, as it corroborated on a larger scale the knowledge of previous experiences that the "get-together" principle, when scientificially applied, works for practical success in business.

Metal-Sawing Machines.

The Railway Appliances Company, Chicago, has built for the American Steel Foundries Company three machines for cutting off gates from steel castings and doing other heavy metal sawing. These machines carry Taylor-Newbold saws 33 inches diameter, and have capacity for cutting off risers up to 11 inches diameter.

The saw blade has a travel of 16 inches, and with the main driving shaft running at a speed of 200 revolutions per minute the saw blade has a periphery speed of 55 feet per minute and a variable feed of from ¼ to 1 inch. By increasing the revolutions of the main shaft the periphery speed and feed are proportionally increased.

The front table, with which the machine is provided, has a lateral movement sufficient to enable proper adjustment after castings have been clamped.

The machines are powerfully driven and very quiet in operation.

New Three-Wire Generator.

The Burke Electric Company, of Erie, Pa., has made a new departure in generators for supplying three-wire systems. The three-wire generators which this company

has designed and placed upon the market are entirely self-contained and require none of the auxiliary apparatus either rotating or stationary, which is necessary in existing three-wire systems. By an improved armature winding and arrangement of conductors the two voltages are generated directly in the armature, a single collector ring being provided for the neutral wire and the current for the outside wires being taken from the commutator in the usual manner. The three-wire generator resembles very closely the standard two-wire generator manufactured by the same company, except that the single collector ring has been added. The generators are furnished both of the engine type and the belted type, and the same guarantees as to temperature rise, overload capacity and efficiency apply to these three-wire generators as for the standard two-wire generators of the manufacturer.

Personal.

Geo. D. Law, of 237 Cherry street, San Francisco, has severed his connection with the *Journal of Electricity, Power and Gas* and will engage in preparing descriptive write-ups of plants, processes and engineering industries and the prospectuses of new enterprises.

J. F. Witmer, of Buffalo, New York, will assume charge of special work for the J. P. White Company, and will devote his attention to hydraulic engineering in foreign fields. His experience with water works in a number of different towns and cities of the United States especially qualifies him for such work.

New Publications.

"Free Hand Lettering." By A. L. Smith. 26 6x9-inch pages, with 4 full-page plates. The Davis Press, Worcester, Mass. Price, 25 cents.

This pamphlet gives some simple alphabets which the average man may reasonably hope to be able to execute, and some useful hints regarding points which need to be observed in order to secure uniformity of appearance.

"Advanced Mechanical Drawing." By A. P. Jamison. 117 6x9-inch pages, with 27 full-page plates and 117 text cuts. John Wiley & Sons, New York. Price, $2

The subjects discussed in this book are isometric drawing, cavalier projection, shadows and perspective. Part II contains a large number of problems, some of which are theoretical and some practical, the latter of which include problems in the intersection and development of surfaces. They relate largely to sheet-metal work, and being true to their name—practical—are particularly good.

The "Kaiserin Auguste Victoria," recently launched at the Vulcan Works, will in gross tonnage excel the "Baltic" by about 1,000 tons.

A Special Job of Worm-Wheel Hobbing.

A hurry-up job of worm-gear cutting was recently handled very satisfactorily in record-breaking time by the Philadelphia Gear Works, Incorporated.

The gear was 48.46 inches pitch diameter, 87 teeth, 1¾-inch pitch. The worm was 8.66 inches outside diameter, 7.54 inches pitch diameter, triple thread, giving a ratio of 29 to 1.

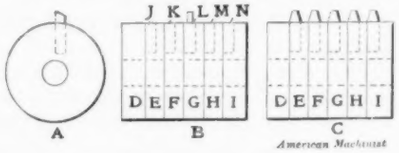


FIG. 1. THE STOCKING AND FINISHING HOB.

There was no suitable hob in stock and the superintendent decided that the time necessary to make one would be better employed in making a device which could be used—with slight alterations—for various pitches, than in making a hob which might never be used again.

The job was done on a Gould & Eberhardt machine. A device for carrying the hobbing arrangement and driving pulley was made and fitted to the guide for the cutter slide as shown in Figs. 2 and 3.

At Fig. 1 the hob is shown; *A* being an end view, *B* a side view of the stocking hob and *C* the same hob body with five inserted cutters for finishing. The hob consists of a series of gray-iron disks *D, E, F, G, H, I,* bored to fit the cutter arbor, their thickness being equal to the pitch of the teeth of the worm wheel. The disk *D* acts as a washer; the others are provided with rectangular slots *J, K, L, M, N* on their sides, into which the cutters are fitted so that the tightening of the nut on the arbor clamps them in position.

At the left of the hob arbor in Figs. 2 and 3 will be seen a sprocket; this sprocket has twelve teeth and is connected with the change gears—used for rotating the work spindle—by a chain and a similar sprocket.

As has been previously stated, the gear has 87 teeth and the worm triple threads;

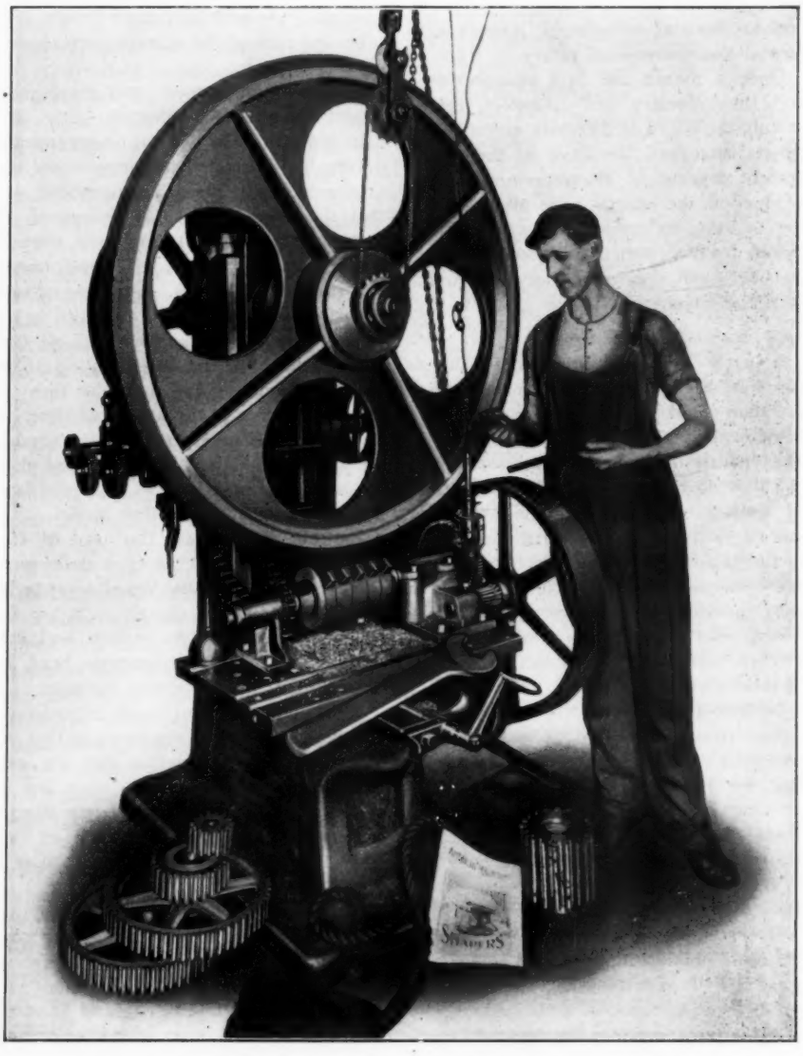


FIG. 2. SHOWING THE WORM-WHEEL BLANK AND FINISHING HOB.

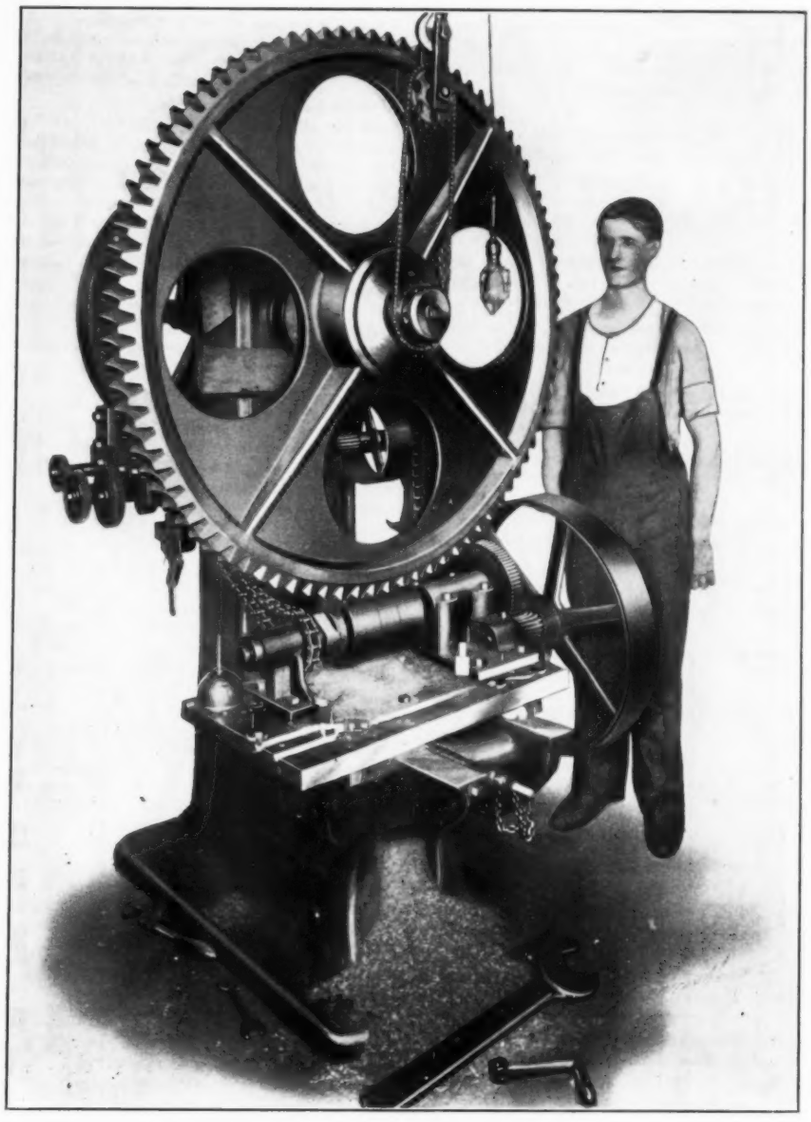


FIG. 3. THE FINISHED GEAR.

as $87 \div 3 = 29$, the change gears were arranged so as to give one turn of the blank to 29 turns of the hob, and in this way one group of 29 teeth was "stocked" out. The chain was then disconnected from the twelve-tooth sprocket on the hob spindle and the hob spindle advanced through four teeth of the twelve-tooth sprocket, and the chain was put on again, care having been taken not to alter its position on the sprocket on the change-gear shaft. This brought the stocking cutter in position to cut another group of 29 teeth. When this group was finished the sprocket was again moved four teeth and the last group cut. The stocking cutter was then removed and the five cutters —shown at *C* in Fig. 1 and in the half-tone, Fig. 2—were put in. The finishing operation was merely a repetition of the stocking operation, being done in three groups of 29 teeth each.

By referring to Figs. 2 and 3, it will be seen that a sprocket is mounted on the end of the work spindle; a chain sling connects it with a similar sprocket supported by a chain hoist from the ceiling. This prevents the work spindle from sagging with the weight of the worm wheel and the action of the hob. Fig. 3 shows the finished gear. At the right hand near the end of the driving pulley spindle may be seen the stocking cutter.

A Combined Payroll and Cost Sheet —Loose-Leaf Cost Accounting.

EDITORIAL CORRESPONDENCE.

The accompanying illustration, Fig. 1, is to me a novelty in cost accounting, which is in very satisfactory use at the works of the Consolidated Press & Tool Company, of Chicago. By means of it the posting of the figures from the time tickets as they come in each day is limited to a single posting for each ticket, the form of the blank being such that this posting serves both for the purpose of the payroll and the cost accounting, while the calculation of the value of the time spent on any job is cut down to one multiplication per man for each pay period—in this case half a month.

The sheet will be seen to have two rows of figures at the top of the columns, these being the days of the month; the row which is of significance in any particular case being shown by an entry, "first" or "second," against the word *half* in the date line at the top. At the beginning of each pay period the bookkeeper starts one of these sheets for each man in the works. The hours chargeable to each job are entered in a line having the job number entered in the *Order No.* column and in the column for the day of the month. One or several entries may be made each day, depending on whether the workman has worked on one or more jobs. For the following days, work on jobs for which entries have been made for previous days are entered *in the same line*, the time belonging to any one job being thus kept in its own line. At the close of the pay period the hours are added horizontally and entered in the *Total Hours* column,

CONSOLIDATED PRESS AND TOOL CO.
SEMI-MONTHLY

DAY LABOR DISTRIBUTION TICKET ——— HALF

Name ——— Department ——— Check No.

Order No.	Class of Work	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total Hours	Cx.	Rate	Amount
Totals																																			

American Machinist

FIG. 1. COMBINED PAYROLL AND COST SHEET—ACTUAL SIZE, 8X9½ INCHES.

the figures appearing in any one line being the totals chargeable to the job for the pay period. The rate is then entered and the amounts in money chargeable to the job for the period are calculated and

entered in the *Amount* column, this multiplication being done but once per pay period for each man instead of daily, as with many other systems. Meanwhile the total of the *Amount* column at the bottom gives the wages due the workman for the period. It will thus be seen that a single original entry serves for both wages accounting and cost accounting.

Fig. 2 shows one side of a cost-ledger sheet, this side being given to the wages entries, which are taken from the total in the *Amount* column of Fig. 1, but two entries for each job being made each month. When an amount is posted it is indicated by a check mark in the *Ck.* column of Fig. 1. The *Check No.* space in Fig. 1 and the *No.* column of Fig. 2 are for the workmen's numbers, the source of entries in Fig. 2 being thus established. The other columns of Fig. 2 give the hours, rates and amounts from Fig. 1, the labor being classified as shown. The opposite side of Fig. 2 is ruled as shown in Fig. 3, and forms the material account for the job of which the wages account is found on the first side. One of the sheets shown in Figs. 2 and 3 is of course started when a job is begun, and when finished it forms a complete record of the cost of the work. The symbol headings at the top and left of Fig. 3 have these meanings: E C—estimated cost; T M—total material; T L—total labor; T C—total cost; S P—selling price.

The sheets are punched at the left for insertion in a loose-leaf binder. The current file of the sheets shown in Fig. 1 is bound consecutively in accordance with the workmen's numbers. At the end of each pay period the collection of sheets is removed from the current file and bound with previous ones, the collection for each period being kept intact and separated from the previous lot by a sheet on which is given a recapitulation of the totals.

Similarly, there are two files of the sheets shown in Figs. 2 and 3, one representing work in progress and the other work which has been completed. These are filed consecutively by number, and are indexed by customer's names.

F. A. H.

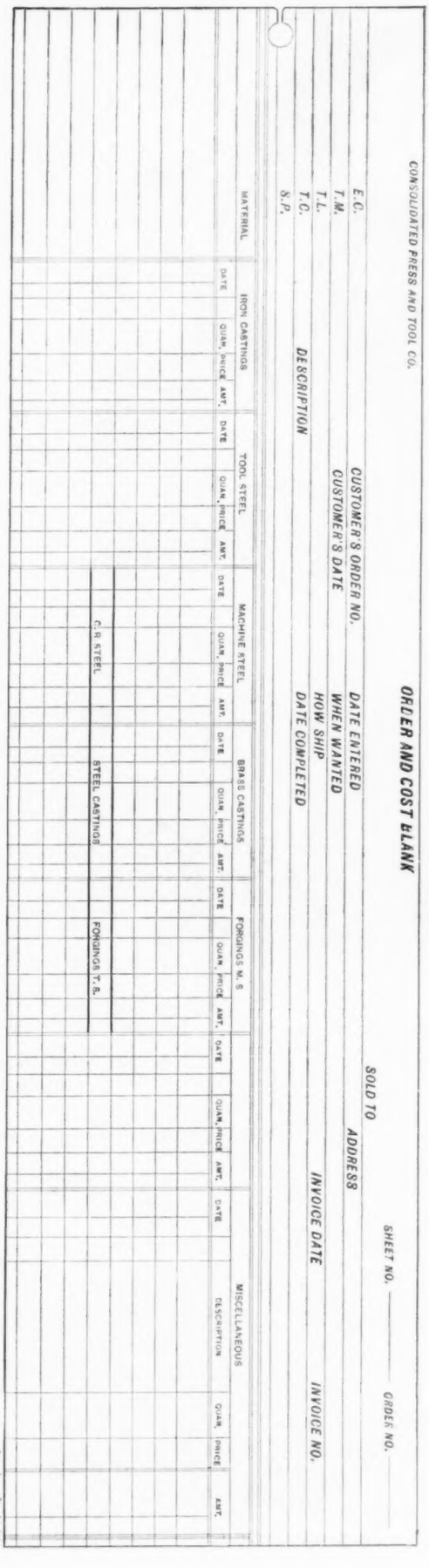


FIG. 3. MATERIAL SIDE OF COST-LEDGER SHEET—ACTUAL SIZE, 11X22 INCHES.

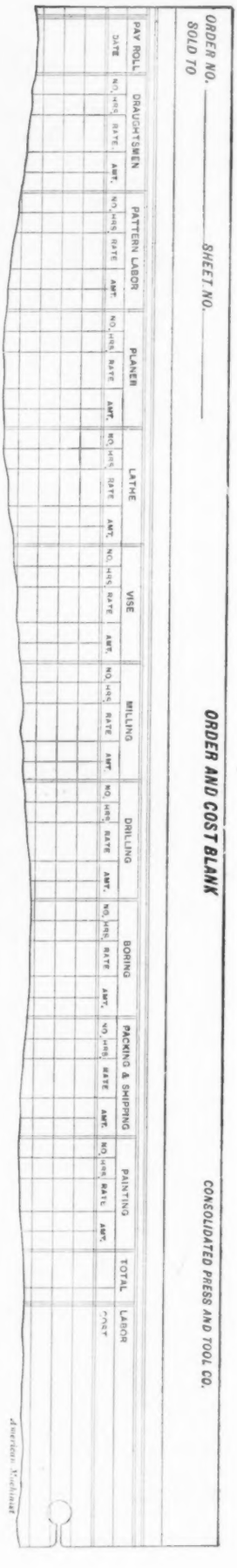


FIG. 2. WAGES SIDE OF COST-LEDGER SHEET—ACTUAL SIZE, 11X22 INCHES.

Business Items.

The B. F. Sturtevant Company, of Boston, Mass., is to install the hot blast heating and ventilating equipment for the addition to the American Pulley Company's plant at Philadelphia, Pa.

The Independent Pneumatic Tool Company, Chicago, Ill., reports a large demand for its "Thor" pneumatic tools. It has recently purchased considerable new machinery for its plant at Aurora, Ill.

Owing to increased business, the Chandler & Farquhar Company, of Boston, machinery dealer and machinists' supplies, has had to increase its floor space, and in addition to its present store on Federal street, it has taken a warehouse, which is located at 417 to 425 Atlantic avenue and runs through to Purchase street. The company will carry a complete line of machine tools in stock.

The American Arc Lamp Company, successor to the Lea Electric Manufacturing Company, of Elwood, Ind., is now located in its new building in Kalamazoo, Mich.

The export, Southern and Western trade is gradually expanding in volume with the Bury Compressor Company, of Erie, Pa. Among the several orders received from France and Belgium, through Fenwick Freres & Co., during the month of September is included one for the French Government. This company has a compressor on exhibition at the International Exhibition at Liège, Belgium.

The Smith Countershaft Company, formerly of Melrose, Mass., manufacturer of the Smith single belt reversing countershafts, has just been reorganized and incorporated, and has moved to 69 and 70 High street, Boston, Mass., where it should be addressed in the future. In the new plant it will have double the former capacity and be able to make prompt deliveries. The officers of the new incorporation are: Andrew Lumsden, president; Chas. Van Stone, vice-president; James Lumsden, secretary and treasurer, and Charles F. Smith, general manager.

The Degnon Contracting Company is contractor for the two tunnels of the Long Island Railroad under the East River, between New York and Long Island City, and has just placed one of the largest machinery orders of recent times with the Ingersoll-Sergeant Drill Company, of New York. This order includes fourteen air compressors, of two different types. Eight are of duplex compound Class "HC" pattern, with steam cylinders 16 and 28 inches in diameter, air cylinders 25¼ and 16¼ inches in diameter, and a stroke of 16 inches. Each unit has a free air capacity of 1,205 cubic feet per minute. The other six are of straight-line Class "A" type, with a 24-inch steam cylinder, 26¼-inch air cylinder and a stroke of 30 inches. The capacity of each is 1,444 cubic feet per minute. The aggregate free air capacity of the fourteen compressors is 18,304 cubic feet per minute. The shield method will be used in driving these tunnels.

Manufacturers.

The Hanna Paint Company, Columbus, O., will erect a new plant.

The Riverside (N. J.) Metal Company will erect a new rolling mill.

The Lawrence Chair Company, Chicago, Ill., will move to La Porte, Ind.

The Globe Varnish Company, Pittsburg, Pa., will erect a new factory.

The Lawrence Dye Works is erecting a new mill in South Lawrence, Mass.

Ogden, Sheldon & Co., Chicago, Ill., will construct a $200,000 warehouse.

The Liberty Brass Foundry Company, Buffalo, N. Y., will build a new factory.

The Harbach Furniture Company, Des Moines, Iowa, will erect a new factory.

A $50,000 plant will be erected for the Northampton (Pa.) Brewing Company.

The Syracuse (N. Y.) Rawhide Manufacturing Company will build a new plant.

The Forest City Paint & Varnish Company, Cleveland, O., will erect a new factory.

The plant of the Union Dish Company, Bradford, Pa., was burned; loss, $25,000.

The Universal Oil & Fertilizer Company, Wilmington, N. C., will build an addition.

The Minneapolis (Minn.) Paper Company will erect a new building, to cost $60,000.

The Cudahy Packing Company will put up a new $20,000 warehouse at Omaha, Neb.

The Heim Machine Company, Danbury, Conn., is building an addition to its factory.

The Minetto (N. Y.) Shade Cloth Company proposes to erect another large factory building.

The Flour City Ornamental Iron Works, Minneapolis, Minn., will build an $8,000 addition.

It is said that the Adjustable Wrench Company, of Chicago, Ill., may locate in Rockford.

Jos. Joseph Bros. & Co., Cincinnati, O., railway iron, metals, etc., will erect a factory.

The Clark Textile Company, of Sidney and Manlius, N. Y., will move its plant to Syracuse.

Contracts have been let for a $22,000 plant at Colonia, Pa., for the Pittsburg Tube Company.

Sargent & Co., New Haven, Conn., hardware manufacturers, have plans for a new plant.

The Springville Manufacturing Company, Rockville, Conn., will erect a new boiler-house.

It is said that the Mechanical Appliance Company, of Milwaukee, Wis., may locate in Waukesha.

It is reported that the Atlantic Coast Line Railroad will build repair shops at Fayetteville, N. C.

It is probable the plant of the Lynchburg (Va.) Foundry Company will be moved to Ironton, O.

The Co-operative Furniture Company, Rockford, Ill., will erect a new dry kiln, to cost about $4,000.

Fire dstroyed one of the mills of the American Woolen Company at Collinsville, Mass.; loss, $50,000.

The Ellingham Company, Des Moines, Ia., is figuring on a new warehouse for cold-storage purposes.

The Greer-Wilkinson Lumber Company, Indianapolis, Ind., will erect a $100,000 plant in Cairo, Ill.

The New Century Gate Company, of Wichita, Kan., expects to open a factory in Des Moines, Iowa.

The Henderson Lithographing Company, Cincinnati, O., will erect a new building, to cost $100,000.

John B. Eastburn, broom manufacturer, Philadelphia, Pa., will move his plant to Newark, N. J.

Jerry Morrow & Sons, Wellston, O., are erecting a factory for the manufacture of trolley wheels.

J. Eavenson & Sons, soap manufacturers, Philadelphia, Pa., will establish a plant in Camden, N. J.

A $75,000 addition to the plant of the Cadillac Automobile Company, Detroit, Mich., will be erected.

The Braughton Mantel Manufacturing Company is being formed at Memphis, Tenn.; capital, $25,000.

The Wisconsin Barrel Manufacturing Company, Superior, Wis., will enlarge the capacity of its cooper shop.

The Wilkins-Leonard Hardware Company, Youngstown, O., has had plans prepared for a $7,000 warehouse.

The American Coil Company, West Somerville, Mass., is making arrangements to move its plant to Foxboro.

The Chatfield Brass & Iron Foundry at Escanaba, Mich., was burned recently. The plant will be rebuilt.

The Richmond (Va.) Cedar Works will enlarge its plant and take up the manufacture of ice-cream freezers.

The Krohn & Fechheimer Shoe Manufacturing Company, Cincinnati, O., will erect a new $125,000 building.

J. H. Emery, Bay City, Mich., will erect machine shops and foundry for the manufacture of brick machines.

The Marshall (Tex.) Compress Association contemplates expending about $10,000 in improvements to its plant.

The plant of the Roberts Chemical Company, Niagara Falls, N. Y., was destroyed by fire; loss, about $80,000.

The Weston-Mott Company, manufacturer of automobile and bicycle parts, Utica, N. Y., will move to Flint, Mich.

The site for the new power-house of the Lehigh Valley Transit Company, at Allentown, Pa., has been selected.

The Matheson Motor Company, Holyoke, Mass., will move to Wilkesbarre, Pa., where a larger plant will be erected.

The Wagner Manufacturing Company, Sidney, O., maker of hollow ware will put up two new buildings at its plant.

The Advance Glass Company has been incorporated at Upland, Ind. Harry Miesse, Wm. T. Wocher, etc., directors.

The Crossley Manufacturing Company, Trenton, N. J., clay-working machinery, will erect a three-story brick addition.

The Flintkote Manufacturing Company, Rutherford, N. J., making roofing paper, will put up an addition, to cost $25,000.

J. A. Windsor, head of the Windsor Automobile Company, Chicago, Ill., purposes to move his factory to Evansville, Ind.

E. S. Bock & Son, Shady Grove, Pa., manufacturers of an adjustable implement holder, will move their plant to Waynesboro.

The Goshen (Ind.) Veneer Company will increase the output of its plant. A new boiler- and engine-room will be erected.

Regen Bros. & Co., have sold their carriage and buggy business at Lynnville, Tenn., and will establish a new plant in Nashville.

The J. J. Case Threshing Machine Company, Racine, Wis., contemplates the erection of a large factory in Manitoba, Canada.

The Lagonda Manufacturing Company, Springfield, O., making boiler-cleaning machines, etc., is looking for larger quarters.

S. R. Dresser & Co., of Bradford, Pa., have secured a plant in Oil City, where they will start the manufacture of oil-well couplings.

The mill and power-house of the Electric Lumber & Manufacturing Company, Fernie, B. C., were destroyed by fire; loss, $100,000.

The Knox Wood Fiber Plaster Company, Knoxville, Tenn., whose plant was recently burned, is now repairing and enlarging same.

The Woodland Shingle Company has been incorporated at Ballard, Wash. C. E. Sutherland, J. J. Harvey and others, incorporators.

The Carnegie Steel Company is to expend $6,000,000 on building a new rail mill, four furnaces and open-hearth plants at Pittsburg Pa.

John S. Seabright, Newville, Pa., will erect a factory for the manufacture of locust pins and cross-arms for telephone and telegraph poles.

The Warner Arc Light Company, Muncie, Ind., has secured a building, which will be equipped with machinery to make a new arc lamp.

Extensive improvements, to cost in the neighborhood of $170,000, will be made at the works of the Bullock Electric Company, Norwood, O.

The People's Economy Ice Company, of Petersburg, Va., has been incorporated. A plant will be erected. Joseph Lambert, Warfield, Va., president.

Mason D. Pratt, Harrisburg, Pa., has been selected to make the plans for the Pennsyl-

vania Traction Company's new power plant in South Harrisburg.

The Needham Flue Stopper Company has been incorporated at Muncie, Ind. F. M. Needham, Charles Needham, Albert Dearth and others, incorporators.

The Progressive Manufacturing Company, of Torrington, Conn., has been incorporated for the purpose of manufacturing screws, engines and machinery. The capital is $100,000, and John F. Alvord, George B. Alvord, etc., of Torrington, are incorporators.

New Catalogues.

E. W. Bliss Company, Brooklyn, N. Y. Catalogue of machinery for the manufacture of pieced tin and ironware. Illustrated, 5x7, pp. 80, paper.

Emmert Manufacturing Company, Waynesboro, Pa. Catalogue No. 4, illustrating and describing the Emmert patent universal vises. 3½x6, pp. 24, paper.

The Scranton Whetstone & Abrasive Wheel Company, Scranton, Pa. Catalogue and price list "O" of different styles of oil stones. Illustrated. 6x9, pp. 41, paper.

Mound Tool & Scraper Company, St. Louis, Mo. 1905 edition of "Engineers' Chums," which describes the various tools made by this company. 3½x6, pp. 9, paper.

The Ferguson Company, 120-122 Liberty street, New York. Folder illustrating and describing the Ferguson combination muffler, oil separator, purifier and feed-water heater.

Acme Gas Company, Chicago, Ill. Catalogue describing the Acme gas plant for fuel, light and power purposes. This has illustrations of several installations and also testimonials. 7x10, pp. 62, paper.

Norton Grinding Company, Worcester, Mass. 1905 catalogue of Norton plain grinding machines. This contains pretty complete data about these machines and excellent half-tone illustrations. 6x9, pp. 41, paper.

T. C. Dill Machine Company, Somerset and Mutter streets, Philadelphia, Pa. Catalogue descriptive of the slotting machines made by this company, containing table of dimensions and half-tone illustrations. 6x9, pp. 20, paper.

Cleveland Pneumatic Tool Company, Cleveland, O. Catalogue "F." This is printed on fine coated paper and describes the "Cleveland" chipping and riveting hammers, drills, Bowes patent hose couplings and other pneumatic appliances. Illustrated, 6x9, pp. 63, paper.

Patterson, Gottfried & Hunter, Ltd., 146-150 Centre street, New York. Catalogue No. 45, illustrating and describing power-transmission appliances handled by this company. 5½x7½, pp. 251, paper. Booklet describing the McClelland improved oil purifier. Illustrated. 5½x8, pp. 8, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin No. 1067, illustrating and describing Type "A" transformers. 8x10½, pp. 8. Bulletin No. 1068, illustrating and describing Type "M" induction motors. 8x 10½, pp. 8. Bulletin No. 1070, illustrating and describing series A. C. arc lighting system. 8x10½, pp. 18.

Wagner Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 72, describing the construction and operation of "Two-in-One Lightning and Motor Transformers." Illustrated. 6x9, pp. 10, paper. Bulletin No. 73, illustrating and describing combined voltmeter and frequency indicator. Pamphlet entitled "Recent Developments in Single-Phase Alternating-Current Motors," by G. Percy Cole. This contains diagrams and illustrations, and should be useful to those interested.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Working drawings made for everything. "Cushman," 303 Broadway, Cambridge, Mass.

Dies and tools for sheet metal designed and constructed; estimates. J. V. Woodworth, 367 Vernon ave., Brooklyn, N. Y.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Manufacturers—If you have any new goods or devices, we want to introduce them for you in this vicinity. Wolverine Supply Co., Pittsburg, Pa.

Wanted—A small machine shop near foundry. Give details of work now doing, description of tools and property, location, terms, etc. Box 589, AMERICAN MACHINIST.

Established firm wants additional metal articles, tools or machines to manufacture; will buy desirable business, patent or idea. Address Box 139, AMERICAN MACHINIST.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted.—An up-to-date and hustling brokerage agency wants the agency for a number of good, reputable manufacturers of machine and electrical supplies and appliances. Address S. B. Schlaudecker Co., Erie, Pa.

Wanted.—A hustling agency in the East wants to handle any good, reputable article that can be guaranteed to purchaser. We know how to sell and can show effects. Address Box 615, AMERICAN MACHINIST.

For Sale.

Pattern shop for sale; good tools and location; plenty good work; cheap rent. "Bargain," care AMERICAN MACHINIST.

For Sale—New Woodward & Powell planer, 36 in., 8 ft. bed; practically never used. National Compositype Co., Baltimore, Md.

$6,000 will buy a $12,000 plant, of machine shop, boiler shop and foundry; business and location of very best. F. Palfrey, Macon City, North Missouri.

For Sale—Rose three-volume "Modern Machine Shop Practice"; would exchange for typewriting machine. E. Krauss, 274 W. 135th st., New York.

For Sale—One "Garvin die slotter"; never been used at all; in A1 condition; for description, see Catalogue No. 11, page 11, Garvin Machine Co. Box 375, AMER. MACHINIST.

For Sale—A quantity of Hermann Boker flat steel, all thin, ¼ to 1 in. width; also a quantity of Phoenix drill rod, sizes 15-55; all will be sold very cheap if entire quantity can be closed out. Address Box 581, AM. M.

Business Opportunities.

Have office and men; wanted, New York agency for machinery. Box 631, AM. MACH.

Patternmaker wanted to buy a fine pattern shop; good tools, location and trade. Box 628, AMERICAN MACHINIST.

High-grade manufacturing, dividend-paying company will entertain good, active business man to buy interest in business. Box 633, AMERICAN MACHINIST.

I want some device or specialty that will form basis of a manufacturing business; would take a partner. B. F. B., 1020 Westinghouse Bldg., Pittsburg, Pa.

Wanted—An active man who can invest $15,000 in a well-established manufacturing corporation in Middle West, and can fill the position of treasurer and general office manager. To such a party a liberal and interesting proposition worthy of investigation will be made. Box 612, AMERICAN MACHINIST.

A Liverpool, England, commission agent wishes an additional agency to work with present lines; 26 years' connection among ironmongers, contractors, etc.; understands import and distribution of goods; could handle American goods to advantage in the United Kingdom; references furnished and required. Reply to Box 573, AMER. MACH.

Advertiser wishes to interest boiler manufacturer in the building of a new water tube boiler. Boiler has straight tubes, all of which can be removed in the firing space; no screwed pipe fittings; brick or sheet steel casing; adapted to land or marine service; can be built in a shop equipped with ordinary tools. Cost of manufacture less than others of same class. Address Box 618, AMER. MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

MAINE.

Technical graduate, 1905, desires position as assistant to superintendent of a manufacturing concern. Box 629, AMER. MACH.

NEW JERSEY.

Mechanical draftsman, 34, seeks an employer of A1 services. "Shop," care AM. M.

Foreman machinist, practical mechanic of varied experience, college and drafting-room training, desires position. Box 638, AM. M.

NEW YORK.

Experienced cost clerk desires position. Box 559, AMERICAN MACHINIST.

First-class toolmaker wants position in N. Y. city. J. M. S., 159 W. 46th St.

Mechanical draftsman wishes position. Address Box 640, AMERICAN MACHINIST.

Draftsman, designer, experienced, seeks position. Box 609, AMERICAN MACHINIST.

A first-class mechanical draftsman wants night or home work. Box 595, AMER. MACH.

Position as assistant superintendent with manufacturing concern; references furnished. Box 621, AMERICAN MACHINIST.

Draftsman, with 9 years' experience in condensers and pumps, is open for engagement. Box 616, AMERICAN MACHINIST.

Superintendent or manager, age 35, thorough mechanic, desires position; A1 references. Box 607, AMERICAN MACHINIST.

Mechanical draftsman, 2 years' experience, desires position; must be in New York city. Address Box 596, AMERICAN MACHINIST.

Foundry foreman wants situation after October 1; capable and energetic; references if required. Address Box 614, AMER. MACH.

Draftsman.—Mechanical draftsman, with 7 years' experience, also having 4 years' practical shop experience, desires position. Box 636, AMERICAN MACHINIST.

General foreman, responsible man, progressive, expert machinist, experienced in high-grade duplicate and general machinery, is open for engagement. Box 611, AM. MACH.

Young man, 23, desires position where he may be advanced as ability proves; 5 years' machine shop experience and 2 years in drafting room. Address Box 626, AMER. MACH.

Foreman, experienced in erecting and testing gas and gasoline engines, desires change; good executive and mechanical ability; excellent references. Address Box 637, AM. M.

Foundry superintendent who has worked up from gang boss to superintendent, now desires to make a change; No. 1 man in all foundry practice; best of references. C., care AMERICAN MACHINIST.

Wanted—A position as superintendent or general foreman, by a thorough, up-to-date mechanic; 20 years' experience in the machine-tool and automobile business. Address Box 597, AMERICAN MACHINIST.

Wanted—Position, superintendent, foreman or toolroom foreman, by superintendent with wide practical experience; technical education; expert tool designer; location immaterial. Box 599, AMERICAN MACHINIST.

Wanted—Position as superintendent of manufacturing plant, or as manager of branch office; machine tools, electrical apparatus, sheet metal goods; a thorough mechanic and first-class salesman. Box 617, AMER. MACH.

Good machinist (34), has been employed by a well-known New York firm a number of

years as foreman and machinist, wants a position where there is opportunity for advancement; good reference. Box 627, AM. MACH.

General foreman desires position; experienced in general work and elevator manufacturing; good, live hustler; accustomed to modern methods of rapid production; good executive ability, and assume full responsibility. Address Box 639, AMER. MACHINIST.

Graduate engineer, age 30, desires position as chief draftsman, engineer, leading designer; 2 years' shop, 8 years' office experience as draftsman, inspector, leading designer on special and small machinery, instruments, jigs, fixtures, gages; inventive, hustler, and bound to win; salary $135 to $150. Box 622, A. M.

Machinery salesman, with experience as inventor, mechanical engineer, erecting man, power plant designer, superintendent and business manager, desires position with a first-class manufacturing firm making a high-grade line of power or other machinery; 20 years' experience; best of references. Address "C. S.," 154 W. 15th st., New York.

In Greater N. Y. or vicinity, the superintendency or mechanical supervision of some good, progressive manufacturing establishment, by a man of rare abilities and exceptional qualifications, in the prime of a healthy life (38 years of age); heavy, medium or light manufacturing; practically familiar with all details of mechanical production of to-day; a cost-reducer and systematizer and all-round expert in the factory; have an absolutely clean record, with exceptional executive ability and long experience. Unless you mean business and are willing to pay a salary commensurate with value received, do not answer this. Address Box 634, AMER. MACH.

OHIO.

Specialist in milling and grinding operations and general time-saving methods; A1 tool designer and maker. Box 440, AM. M.

PENNSYLVANIA.

Situation Wanted.—Have for more than 10 years made a specialty of universal and surface grinding on a high class of work. Box 635, AMERICAN MACHINIST.

Mechanical and architectural engineer and draftsman is open for engagement; Corliss engines, blowing and pumping engines, gas engines, power stations; competent to take charge. Address Box 630, AMER. MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Grinder and lathe hands. Bantam Anti-Friction Co., Bantam, Conn.

Wanted—Salesman to handle quick-selling side line, small bench tools. "Gardner," care AMERICAN MACHINIST.

Wanted—Good toolmakers; men of experience; state what your line of work has been. Address your reply to "G. C.," care AM. M.

Wanted—First-class blacksmith, accustomed to machine forging and use of steam hammer; state age and wages expected; none but first-class men need apply. Box 623, AM. MACH.

ILLINOIS.

Feed and speed foreman for a machine shop employing 75 machinists on large and small machine tools; man with energy and aggressiveness wanted; state age, past experience and salary desired. Box 567, AMER. MACH.

MASSACHUSETTS.

Wanted—Young man, experienced in gear work, for office and shop assistant. Boston Gear Works, Boston, Mass.

NEW JERSEY.

Wanted—By engineering firm, draftsman; young; must have had some experience. Reply Box 625, AMERICAN MACHINIST.

Wanted—Draftsman for tool, fixture and general shop equipment; shop experience essential. Address Box 605, AMER. MACH.

Wanted—Immediately, several A1 engine draftsmen, experienced in laying out and checking; give full particulars, salary, date can report, etc.; married preferred. The Ball & Wood Co., Elizabethport, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark, N. J.

Wanted—A technical graduate with 6 years' experience in general mill work; should have had some experience in mill construction, repairs to machinery, to power plants, to shafting and also in direct-current electrical work, and in general mill piping and drafting; state salary wanted and send references. Address "Technical," care AMERICAN MACHINIST.

Wanted—An assistant superintendent for a machine shop near Philadelphia, employing about 400 hands, on small interchangeable work; a thoroughly systematic man, experienced in the handling of men, who can produce, economically, duplicate work in large quantities, without excuses, is required; do not apply if you are not worth $3,000 per year to us; applicants are requested to state where now employed, length of time of such employment, age, references and qualifications for this position. Address Box 540, AM. M.

NEW YORK.

Wanted—Draftsman, experienced in jig and fixture work; good position. Address Box 641, AMERICAN MACHINIST.

Wanted—Mechanical draftsman to work under direction of designer; state age, experience, salary expected and give references. Box 619, AMERICAN MACHINIST.

Several experienced draftsmen wanted on construction work; location, N. Y. city; permanent positions to good men; state age, nationality, experience and salary expected. Box 590, AMERICAN MACHINIST.

Wanted—Foreman to take charge of toolroom in a large manufacturing plant, where tools and gages are repaired and stored; must have had experience in this line; state age, salary and give references. Box 620, AM. M.

Wanted—First-class die-sinker, familiar with automobile and bicycle drop forging, to take charge of dieroom; about 20 hands; young man preferred; state age, references and wages expected. Address "Dieroom," care AMERICAN MACHINIST.

Wanted—An outside man to sell shafting, pulleys, hangers, etc.; must be experienced and capable of laying out transmission drives; state age, experience, reference and salary expected, or no attention paid to application. Box 632, AMERICAN MACHINIST.

Wanted—Superintendent with experience in the manufacture of first-class machine tools; must be energetic, with good executive ability; technical graduate preferred; an excellent opportunity for the right man; state age and past experience. Address "Machinery Manufacturer," care AMER. MACHINIST.

OHIO.

Wanted—Young foreman for bench and drill press work, for large and small engines. The Lane & Bodley Co., Cincinnati, O.

Wanted—Designers and detailers on heavy machine tool work; state age and experience. The Niles Tool Works Co., Hamilton, Ohio.

PENNSYLVANIA.

Wanted—First-class vise and floor hands; steady work for competent men. Apply Stoever Foundry & Manufacturing Co., Myerstown, Pa.

Vise hands or fitters on machine tool work; modern shop; no trouble; applicants should state past experience. Standard Engineering Co., Ellwood City, Pa.

Machinists wanted; men familiar with vise and lathe work; those accustomed to medium class of work preferred; steady work and good pay to the right men. Box 591, AM. M.

Wanted—Good, live hustler as foreman for machine shop; gray iron work; must be accurate workman and capable of handling jig work; good pay to right man; give full particulars as to age, experience, etc. Address The Taper-Sleeve Pulley Works, Erie, Pa.

Foreman to take charge of modern equipped machine shop; 100 men; must be accustomed to modern methods of rapid production in a miscellaneous class of work; reply promptly, giving age, experience and salary expected. Address "X. Y.," care AMERICAN MACHINIST.

Wanted—Salesman to sell presses and other tools for sheet metals; lively man with practical knowledge and business tact required; chance for bright mechanic who would like to go on the road. Address, stating detailed experience, etc., Box 613, AMER. MACHINIST.

A bright and active young mechanic, who is familiar with manufacturing and understands the use of special tools, jigs, etc., sufficiently to understand the classification of same so they can be fitted in drawers in a systematic manner for keeping in a toolroom; give age, reference and wages. Box 624, A. M.

WEST OF MISSISSIPPI.

Wanted—Office salesman and correspondent; must have general mechanical training and general familiarity with slide-valve engines and boilers, and preferably with sawmill and pneumatic machinery, to act as assistant secretary and to make occasional trips; salary commensurate with ability. Curtis & Co. Mfg. Co., St. Louis, Mo.

WISCONSIN.

Wanted—Experienced operators for Jones & Lamson and Gisholt turret lathes; also experienced toolmakers. Address Box 606, A. M.

Alphabetical Index to Advertisers.

	PAGE
Abrasive Material Co.	22
Acme Machinery Co.	34
Adams Co., The	33
Albro-Clem Elevator Co.	100
Allington & Curtis Mfg. Co.	90
Almond Mfg. Co., T. R.	97
American Gas Furnace Co.	14
American Pulley Co.	16
American Tool Works Co.	8
American Tool & Mach. Co.	107
American Tube & Stamping Co.	33
Armstrong Bros. Tool Co.	105
Auburn Ball Bearing Co.	90
Aurora Tool Works	90
Automatic Machine Co.	94
Baird Machinery Co.	88
Baker Brothers	24
Baldwin Chain & Mfg. Co.	105
Baldwin Steel Co.	102
Ball Bearing Co.	34
Barnes Co., B. F.	85
Barnes Co., W. F. & John	14
Barnett Co., G. & H.	4th Cover
Bartlett, E. E.	100
Bay State Stamping Co.	107
Bay State Tap & Die Co.	88
Beaman & Smith Co., The	15 and 96
Becker-Brainard Milling Machine Co.	13
Bertram & Sons Co., Ltd., John	14
Besly & Co., Chas. H.	30
Bethlehem Fdry. & Mach. Co.	91
Bickford Drill & Tool Co.	10
Bignall & Keeler Mfg. Co.	102
Bilgram, Hugo	34
Billings & Spencer Co.	33
Binsse Machine Co.	34
Birdsboro Steel Foundry & Machine Co.	24
Blaisdell Machinery Co.	95
Blanchard Mach. Co.	34
Bliss Co., E. W.	25
Blount Co., J. G.	22
Boker & Co., Hermann	83
Boston Gear Works	100
Boynton & Plummer	88
Bradford Machine Tool Co.	5
Bridgeford Mach. Tool Wks.	16
Bristol Co.	4th Cover
Brown-Cochran Co.	106
Brown & Co., R. H.	96
Brown & Sharpe Mfg. Co.	73 and 4th Cover
Brown Hoisting Mach. Co.	104
Buckeye Steel Castings Co.	88
Buffalo Forge Co.	4th Cover
Builders Iron Foundry	3d Cover
Bullard Auto. Wrench Co.	108
Bullard Machine Tool Co.	32
Burke Electric Co.	29
Butler, A. G.	85
Caldwell & Son Co., H. W.	104
Carborundum Co., The	20
Card Mfg. Co., S. W.	17
Carpenter Tap & Die Co., J. M.	99
Case Mfg. Co.	104
C & C Electric Co.	26
Chambersburg Engr. Co.	91
Chandler & Farquhar	86
Chattanooga Machinery Co.	89
Chicago Rawhide Mfg. Co.	100
Christensen, N. A.	108
Cincinnati Machine Tool Co.	29
Cincinnati Milling Mach. Co.	6 and 7
Cincinnati Planer Co.	9
Cincinnati Shaper Co.	110
Clark Cast Steel Cement Co.	84
Clark, Jr., & Co., Jas.	24
Cleveland Auto. Mach. Co.	18
Cleveland Crane & Car Co.	104
Cleveland Pneumatic Tool Co.	108
Cleveland Twist Drill Co., The	4th Cover
Clough, R. M.	94
Contes Clipper Mfg. Co.	102
Coes Wrench Co.	23
Colburn Machine Tool Co.	22
Columbia Corres. Schools	94
Columbus Machine Co.	106
Cook Co., Asa S.	85
Crane Co.	107
Crescent Forgings Co.	25
Cresson Co., Geo. V.	91
Crocker-Wheeler Co.	93
Crosby Steam Gage & Valve Co.	17
Cumberland Steel Co.	85
Curtis & Co. Mfg. Co.	104
Curtis & Curtis Co.	105
Cushman Chuck Co.	96
Cutler-Hammer Clutch Co.	28
Dallett Co., Thomas H.	105
Davis, Rodney	100
Desmond-Stephan Mfg. Co.	97
Detrick & Harvey Mach. Co.	91
Diamond Machine Co.	3d Cover
Dill Machine Co., T. C.	22
Dixon Crucible Co., Joseph	107
Draper Machine Tool Co.	22
Dreses Machine Tool Co.	84
Druckleib, C.	108
Dwight Slate Machine Co.	101
Earle Gear & Mach. Co.	101
Eberhardt Bros. Machine Co.	100
Eck Dynamo & Motor Wks.	28
Electro-Dynamic Co.	27
Erie Forge Co.	16

PAGE

Errington, F. A. 97
Evans Friction Cone Co. 89
Excelsior Needle Co. 89

Fairbanks Co. ..... 20 and 88
Farrel Fdry. & Machine Co. .. 102
Fawcus Machine Co. 100
Fellows Gear Shaper Co. 100
Fenn-Sadler Machine Co. 85
Field, Chas. H. 28
Firth-Stirling Steel Co. 102
Fitchburg Machine Works 30
Foos Gas Engine Co. 106
Fosdick Machine Tool Co. 15
Franklin Mfg. Co. 25
Frost, Edward J. 103

Garvin Machine Co., The 95
General Electric Co. 26
General Mfg. Co. 84
General Pneumatic Tool Co. .. 109
Geometric Tool Co. 29
Gilmore Electric Co. 28
Gleason Works ..... 4th Cover
Goldschmidt Thermit Co. 102
Gorton Machine Co., Geo. 107
Gould & Eberhardt 77
Graham Mfg. Co. 89
Giant Gear Works 100
Gray Co., G. A. 34
Gray & Prior Mach. Co. 104
Greaves, Klusman & Co. 105
Greenfield Machine Co. 97
Greenwald Co., I. & E. 100

Hammacher, Schlemmer & Co. 79
Hampden Corundum Wheel Co. 96
Harrington, Son & Co., Inc., Edw. 92
Hartford Steam Boiler Insp. & Ins. Co. 106
Hendey Machine Co. 81
Henley Publishing Co., Norman W. 85
Henry & Wright Mfg. Co. 24
Heppenstall Forge & Knife Co. 85
Herron & Bury Mfg. Co. 108
Hess-Bright Mfg. Co. 89
Hill, Clarke & Co. 88
Hill-Standard Mfg. Co. 89
Hilles & Jones Co. 88
Hisey-Wolf Machine Co. 107
Hoefer Mfg. Co. 14
Hoggson & Pettis Mfg. Co. .. 96
Horsburgh & Scott Co. .. 4th Cover
Horton & Son Co., E. 96
Hunt Co., C. W. 88
Hunt & Co., Robt. W. 106
Hyatt Roller Bearing Co. 24

Ingalls & Co. 103
Ingersoll Milling Mach. Co. .. 89
Ingersoll-Sergeant Drill Co. .. 109

PAGE

International Specialty Co. .. 97
Iroquois Machine Co. 84

Jacobs Mfg. Co. 96
Jacobson Mach. Mfg. Co. 106
Jantz & Leist Electric Co. 28
Jeffrey Mfg. Co., The 86
Jenkins Brothers 107
Johnson Machine Co., Carlyle. 25
Jones & Lamson Machine Co. 12 and 34

Kent & Co., Edwin R. 102
Keystone Watch Case Co. ..... 86 and 87
Kilbourne & Jacobs Mfg. Co. . 103
King Machine Tool Co. 84

Landis Machine Co. 106
Landis Tool Co. 75
Lapointe Machine Tool Co. .. 90
Le Blond Machine Tool Co., R. K. ..... 4th Cover
Le Count, Wm. G. 96
Link-Belt Engineering Co. 93
Lockwood, Arthur J. 103
Lodge & Shipley Mch. Tool Co. 4
Long & Allstatter Co., The ... 91
Lucas, J. L. 108
Lunkenheimer Co., The 107

McCabe, J. J. ..... 24 and 86
McDowell, Stocker & Co. 88
McGlehan & Co., C. H. 90
McInnes Steel Co. 102
Maris Bros. 104
Marshall & Huschart Mch. Co. 87
Massachusetts Saw Works 84
Massey Machine Co. 20
Mechanical Accountant Co. ... 85
Merrell Mfg. Co. 91
Merritt & Co. 99
Mietz Iron Fdry. & Mach. Works, August 106
Millers Falls Co. 97
Miner & Peck Mfg. Co. 105
Moore Co., Franklin 104
Morse Chain Co. 99
Morse Twist Drill & Mach. Co. 33
Morse, Williams & Co. 101
Motch & Merryweather Mchry. Co. 87
Mueller Mach. Tool Co. 107
Mutual Machine Co. 94

National-Acme Mfg. Co. 110
National Corundum Wheel Co. 97
New Britain Machine Co. 106
New Era Gas Engine Co. 106
New Haven Mfg. Co. 103
New Process Raw Hide Co. .. 101
New Process Twist Drill Co. .. 107
Newton Mach. Tool Wks., Inc. 11

PAGE

Nicholson File Co. 17
Nicholson & Co., W. H. 90
Niles-Bement-Pond Co. ..... 86, 88, 111, 112, 113 and 114
Northern Electrical Mfg. Co. . 27
Northern Engineering Works. 104
Norton Emery Wheel Co. 77
Nuttall Co., R. D. 100
Nutter, Barnes & Co. 99

Obermayer Co., S. 90
O. K. Tool Holder Co. 94
Owen Machine Tool Co. 104

Parker Co., Chas. 90
Patterson, Gottfried & Hunter, Ltd. 95
Pattison Mchry. Co., W. M. 88 and 105
Pawling & Harnischfeger 104
Paxson Co., J. W. 99
Philadelphia Bourse 103
Philadelphia Gear Works 100
Phillips & Sons Co., F. R. 94
Phoenix Mfg. Co. 85
Poole Co., J. Morton 103
Potter & Johnston Mach. Co. 81
Pratt Chuck Co. 96
Pratt & Whitney Co. ..... 2 and 3
Prentiss Tool & Supply Co. .. 86

Rand Drill Co. 108
Ransom Mfg. Co. 89
Raser Gas Engine Works 106
Reed Mfg. Co. 89
Reeves Pulley Co. 106
Reichhelm & Co., E. P. .. 4th Cover
Reliance Machine & Tool Co. 103
Rivett-Dock Co. ..... 3d Cover
Rivett Lathe ..... 3d Cover
Robbins, L. 88
Rogers, Boat, Gage & Drill Works, John M. 84
Rowbottom Machine Co. 90

Safety Emery Wheel Co. 97
Saunders' Sons, D. 89
Sawyer Gear Works 100
Schieren & Co., Chas. A. 31
Schumacher & Boye 9
Schwerdtle Stamp Co. 100
Scranton & Co. 89
Sebastian Lathe Co. 85
Sellers & Co., Inc., William .. 34
Seneca Falls Mfg. Co. 99
Shelby Steel Tube Co. 104
Shultz Belting Co. 89
Sibley Machine Tool Co. 28
Simonds Mfg. Co. 101
Skinner Chuck Co. 96
Slocomb Co., J. T. 85
Smith & Mills 97
Speed Changing Pulley Co. ... 85

PAGE

Sprague Electric Co. 26
Springfield Machine Tool Co. . 30
Standard Engineering Works. 102
Standard Gauge Steel Co. 103
Standard Tool Co. 9
Stanley G. I. Elec. Mfg. Co. .. 92
Stark Tool Co. 85
Starrett Co., L. S. 83
Stoever Fdry. & Mfg. Co. 94
Struthers-Wells Co. 106
Sturtevant Co., B. F. 23
Syracuse Raw Hide Co. 100

Taylor-Wilson Mfg. Co. 100
Three Rivers Tool Co. 14
Toomey, Frank 86
Triumph Electric Co. 28
Trump Brothers Machine Co. 96

Underwood & Co., H. B. 106
Union Twist Drill Co. 79
Universal Drafting Mach. Co. 1
U. S. Foundry & Sales Co. 102

Vandyck Churchill Co. 19
Veeder Mfg. Co. 89
Vickers, Sons & Maxim 103
Vitrified Wheel Co. 97

Wallace Supply Co. 94
Ward & Sons, Edgar T. 102
Warner Instrument Co. 92
Warner & Swasey Co. 75
Waterbury Farrel Foundry & Mach. Co. 108
Watson-Stillman Co. 31
Webster & Perks Tool Co. 89
Wellman Sole Cutting Mach. Co. 95
Wells Bros. Co. 31
West Haven Mfg. Co. .. 4th Cover
Westinghouse Elec. & Mfg. Co. 27
Westmacott Co., J. M. 106
Whatley, A. H. 85
Whitcomb-Blaisdell Machine Tool Co. 21
Whitman & Barnes Mfg. Co. .. 92
Whitney Mfg. Co. 71
Whiton Mach. Co., D. E. 96
Wiley & Russell Mfg. Co. 28
Wiley & Sons, John 34
Williams & Co., J. H. 90
Wilmarth & Morman Co. 107
Windsor Machine Co. 105
Wood's Sons, T. B. 99
Woodward & Powell Planer Co. 90
Worcester Mach. Screw Co. .. 105
Wormer Machinery Co., C. C. . 87
Wyke & Co., J. 96
Wyman & Gordon ..... 4th Cover

Yale & Towne Mfg. Co. 94

Classified Index of Articles Advertised.

Abrasive Materials

Abrasive Material Co., Phila., Pa.
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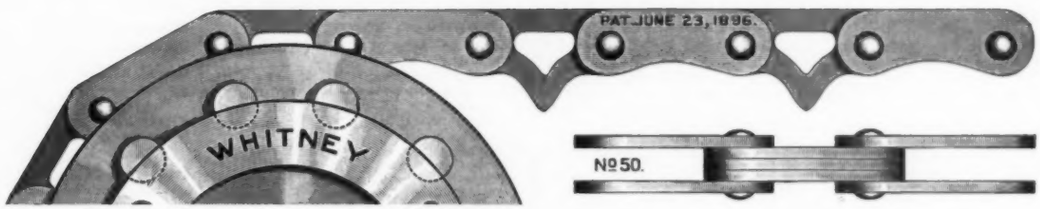

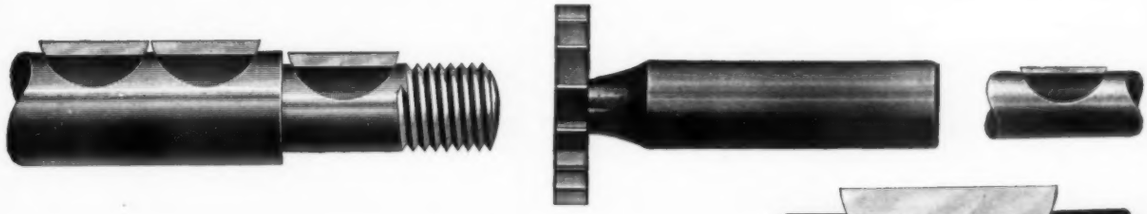

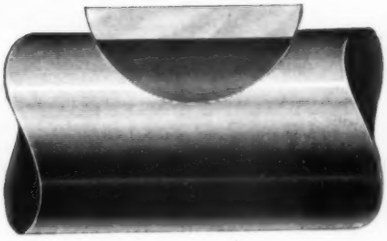

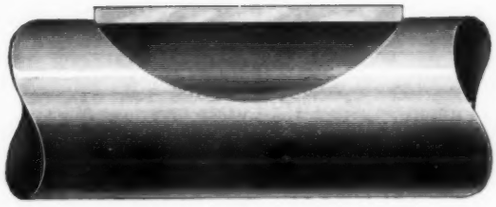

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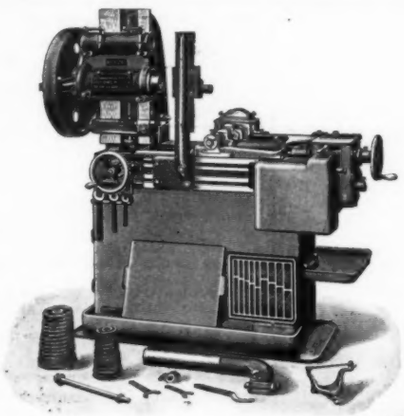

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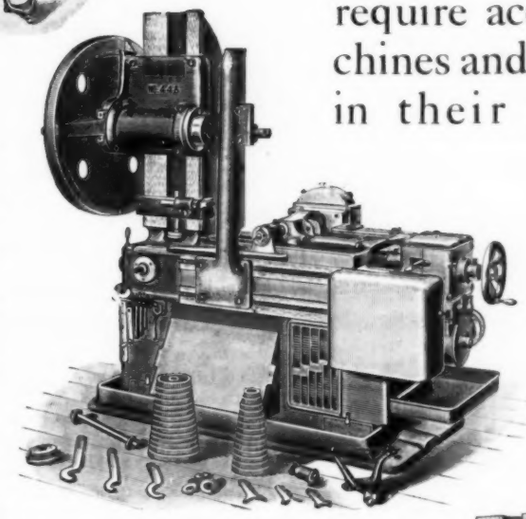

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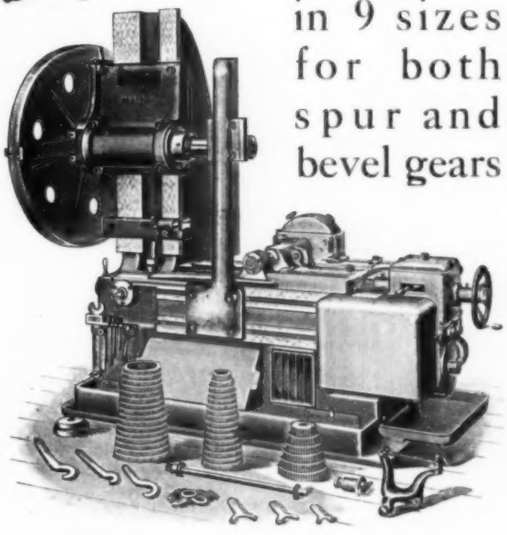

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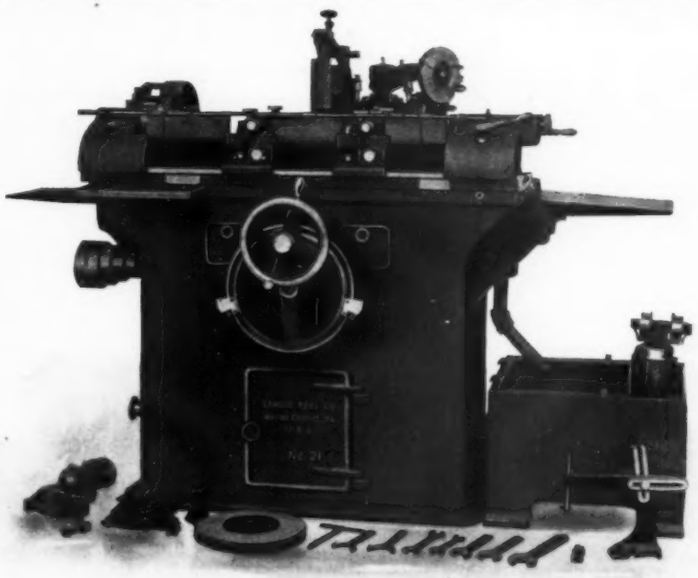

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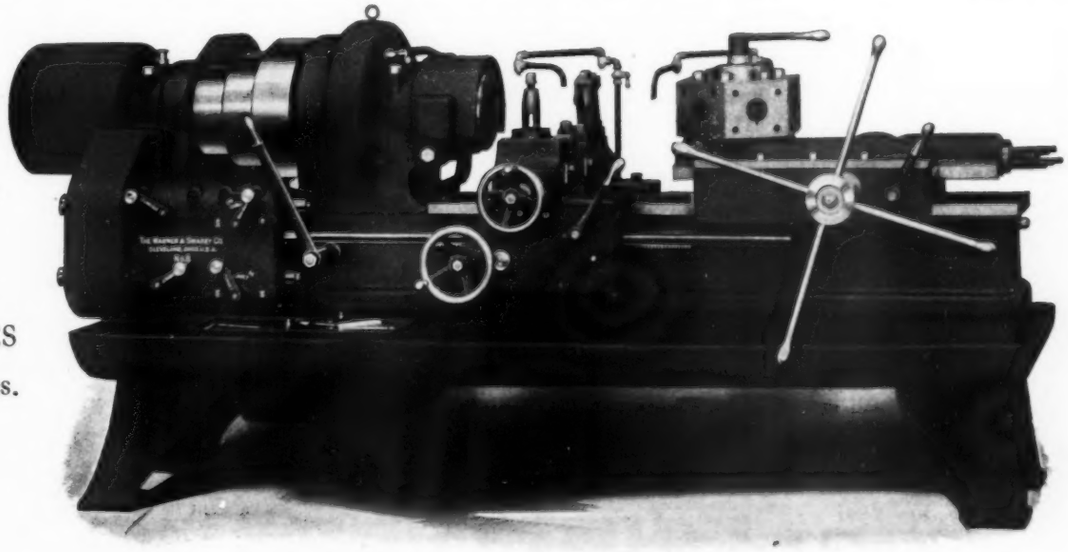

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Whitney Mfg. Co., Hartford, Ct.

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Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.

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Milling Machines, Horizontal
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Pratt & Whitney Co., Hartford, Conn.

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Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
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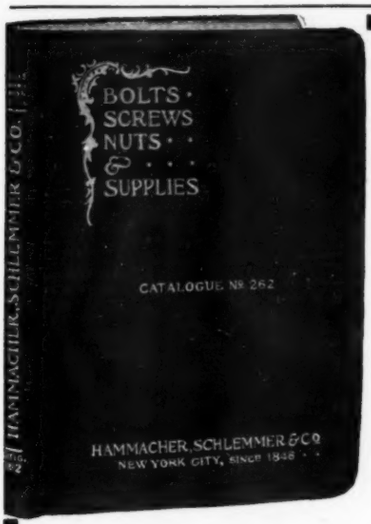

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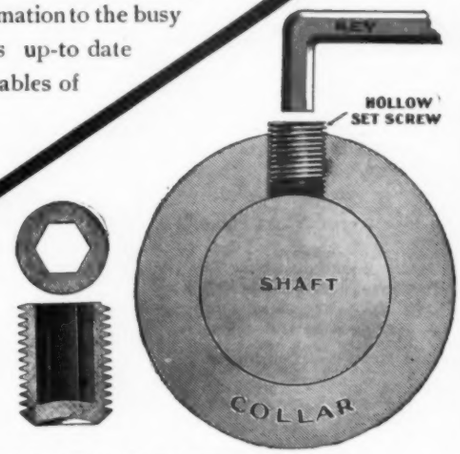

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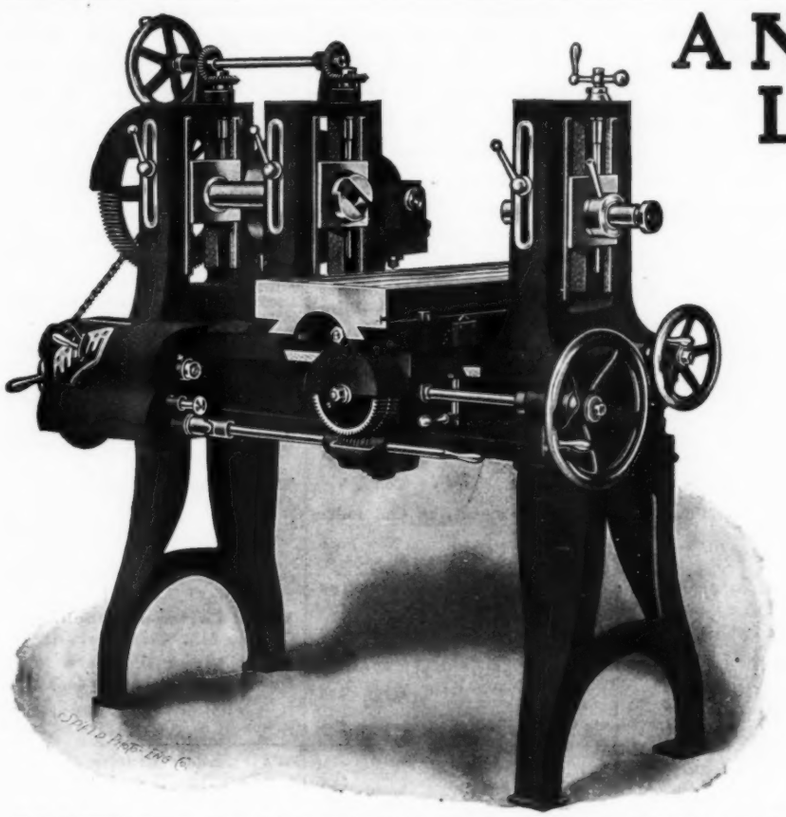

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The Hendey Machine Co.,

Torrington, Conn.

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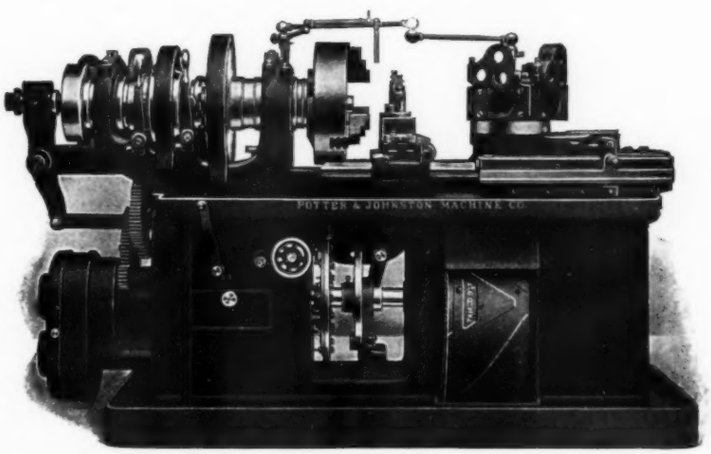
The Potter & Johnston Manufacturing Automatic Chucking and Turning Machine

IS A PRODUCER.

It gets things done promptly and accurately, and without fuss or bother.



It is for the automatic machining of duplicate castings in iron, steel or bronze, and for forgings coming within 14" diameter by 7". Inasmuch as all operations are automatically performed, it is possible for one man to keep from four to eight of these machines busy, all that is necessary being to keep the machines fed with work. Special Bulletins describe fully.

Potter & Johnston Machine Company, **Pawtucket, R. I., U. S. A.**

New York Office, 126 Liberty Street, Walter H. Foster, Mgr. **Cleveland Office, 513 Williamson Building.**

BRANCH OFFICES: Boston, Philadelphia, Pittsburg, Chicago. PARIS OFFICE: 54, Avenue de Neuilly, J. Ryan, Mgr. FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle, England, and Glasgow, Scotland. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm, St. Petersburg, Milano. H. W. Petrie, Toronto and Montreal, Canada.

Slide Rests—*Continued*
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Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Sockets and Sleeves
New Process Twist Drill Co., Taunton, Mass.
Standard Tool Co., Cleveland, O.

Special Machines and Tools
Beaman & Smith Co., Prov., R. I.
Bilgram, Hugo, Philadelphia, Pa.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Blanchard Mach. Co., The, Boston, Mass.
Crescent Forgings Co., Oakmont, Pa.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Machine Co., Hartford, Conn.
General Mfg. Co., New York.
Hoefer Mfg. Co., Freeport, Ill.
Lucas Mch. Tool Co., Cleveland, Ohio.
Massey Mach. Co., Watertown, N. Y.
Mechanical Accountant Co., Providence, R. I.
Mechanics Machine Co., Rockford, Ill.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Queen City Mach. Tool Co., Cincinnati, O.
Simonds Mfg. Co., Pittsburg, Pa.
Torrington Mfg. Co., Torrington, Conn.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Wellman Sole Cutting Mach. Co., Medford, Mass.
Whatley, A. H., Providence, R. I.

Speed Changing Countershafts
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Sprockets
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Wks., Boston, Mass.

Stampings, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.

Stampings, Welded
American Tube & Stamping Co., Bridgeport, Conn.
Standard Welding Co., Cleve., O.

Stamps, Steel
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties
Crane Co., Chicago, Ill.
Jenkins Bros., New York.
Lunkenheimer Co., Cincinnati, O.

Steel Machinery
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Morton & Co., B. K., Toronto, Canada.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Sheet
American Tube & Stamping Co., Bridgeport, Conn.
Union Drawn Steel Co., Beaver Falls, Pa.
Ward & Son, Edgar T., Boston, Mass.

Steel, Tool
American Tube & Stamping Co., Bridgeport, Conn.
Baldwin Steel Co., New York.
Boker & Co., Hermann, New York.
Firth-Sterling Steel Co., Demmler, Pa.
Kent & Co., Edwin R., Chicago, Ill.
McInnes Steel Co., Corry, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Union Drawn Steel Co., Beaver Falls, Pa.

Steel, Tool—*Continued*
Vickers, Sons & Maxim, Sheffield, England.
Ward & Son, Edgar T., Boston, Mass.

Straightening Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Fitchburg Machine Works, Fitchburg, Mass.
Hartford Mach. Screw Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.

Straighteners, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Swaging Machines
Excelsior Needle Co., Torrington, Conn.

Switchboards
C & C Electric Co., New York.
General Electric Co., New York.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Switches
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Stanley Elec. Mfg. Co., Pittsfield, Mass.

Tapes, Measuring
Keuffel & Esser Co., New York.
Starrett Co., L. S., Athol, Mass.

Tap Holders
Errington, F. A., New York.

Tapping Machines and Attachments
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Beaman & Smith Co., The, Providence, R. I.
Bickford Drill & Tool Co., Cin., O.
Cincinnati Mach. Tool Co., Cincinnati, O.
Errington, F. A., N. Y. City.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Geometric Tool Co., New Haven, Conn.
Gould & Eberhardt, Newark, N. J.
Hart Mfg. Co., Cleveland, O.
Hartford Mach. Screw Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Webster & Perks Tool Co., Springfield, O.
Whitney Mfg. Co., Hartford, Ct.

Taps and Dies
Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Card Mfg. Co., S. W., Mansfield, Mass.
Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Taps, Collapsing
Geometric Tool Co., New Haven, Conn.
Hemming Bros., New Haven, Conn.

Telephones
N. Y. Telephone Co., New York.

Thermit
Goldschmidt Thermit Co., New York.

Thread Cutting Tools
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.

Time Recorders
Simplex Time Recorder Co., Gardner, Mass.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Hill-Standard Mfg. Co., Anderson, Ind.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Tools, Small
See Machinists' Small Tools.

Transformers and Converters
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Transmission Machinery
American Pulley Co., Phila., Pa.
Caldwell & Son Co., H. W., Chicago, Ill.
Case Mfg. Co., Columbus, O.
Cresson & Co., Geo. V., Philadelphia, Pa.
Eastern Machinery Co., New Haven, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Traps, Steam
Sturtevant Co., B. F., Hyde Park, Mass.

Trolleys and Tramways
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Yale & Towne Mfg. Co., New York.

Tubing, Steel
Almond Mfg. Co., T. R., Brooklyn, N. Y.
American Tube & Stamping Co., Bridgeport, Conn.

Turret Heads
Almond Mfg. Co., T. R., Brooklyn, N. Y.

Turret Machines
American Tool & Mach. Co., Boston, Mass.
Automatic Mach. Co., Greenfield, Mass.
Bradford Mach. Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Mach. Tool Co., Bridgeport, Conn.
Dreses Mach. Tool Co., Cincin., O.
Garvin Mach. Co., New York.
Gisholt Mch. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Mch. Co., Springfield, Vt.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Massey Mach. Co., Watertown, N. Y.
Niles-Bement-Pond Co., New York.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Pratt & Whitney Co., Hartford, Conn.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, Ohio.
Windsor Mach. Co., Windsor, Vt.

Twist Drills
Boker & Co., Hermann, New York.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Morse Twist Drill & M. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Universal Joints
Baush Mach. Tool Co., Springfield, Mass.
Boston Gear Wks., Boston, Mass.
Gould & Eberhardt, Newark, N. J.
Gray & Prior Mach. Co., Hartford, Conn.
Mutual Machine Co., Hartford, Conn.

Unions, Brass
Lunkenheimer Co., Cincinnati, O.

Valves
See Steam Specialties.

Vises, Metal Workers'
Hammacher, Schlemmer & Co. New York.
Millers Falls Co., New York.
Parker Co., Chas., Meriden, Conn.
Reed Co., H. E., Erie, Pa.
Reed Mfg. Co., Erie, Pa.
Williamson Mfg. Co., Bradford, Pa.

Vises, Pipe
Curtis & Curtis Co., Bridgeport, Conn.
Saunders' Sons, D., Yonkers, N. Y.
Williamson Mfg. Co., Bradford, Pa.

Vises, Planer and Shaper
American Tool Wks. Co., Cin., O.
Cincinnati Planer Co., Cincin., O.
Hendey Mach. Co., Torrington, Conn.
Niles-Bement-Pond Co., New York.
Queen City Mach. Tool Co., Cincinnati, O.

Vises, Universal Machine
Graham Mfg. Co., Provi., R. I.

Vises, Wood Workers'
Hammacher, Schlemmer & Co., New York.
Parker Co., Chas., Meriden, Conn.
Wyman & Gordon, Worcester, Mass.

Watchmen's Clocks
Simplex Time Recorder Co., Gardner, Mass.

Welding
Goldschmidt Thermit Co., New York.

Welding, Electric
American Tube & Stamping Co., Bridgeport, Conn.
C & C Elec. Co., New York.
Standard Welding Co., Cleveland, Ohio.

Welding Machines
Long & Allstatter Co., Hamilton, Ohio.

Welding Plates
Phillips & Sons Co., F. R., Philadelphia, Pa.

Wire-Drawing Machinery
Iroquois Mach. Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Wire-Straightening Machinery
Hoefer Mfg. Co., Freeport, Ill.

Wood Working Machinery
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Worm Hobbing Machines
Pratt & Whitney Co., Hartford, Conn.

Worm Milling Machines
Cleveland Automatic Mach. Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn

Wrenches, Drop Forged
Billings & Spencer Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Wrenches, Machinists'
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Billings & Spencer Co., Hartford, Conn.
Coes Wrench Co., Worcester, Mass.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Wrenches, Pipe
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Bullard Automatic Wrench Co., Providence, R. I.